

CTR 002



FIG. 2

Example:

TF1=15.325 microsec - High_capacity = OC-192

TF2 = 125 microsec - Low_capacity = OC-3

$\Rightarrow c = 64 = (OC-192/OC-3)$

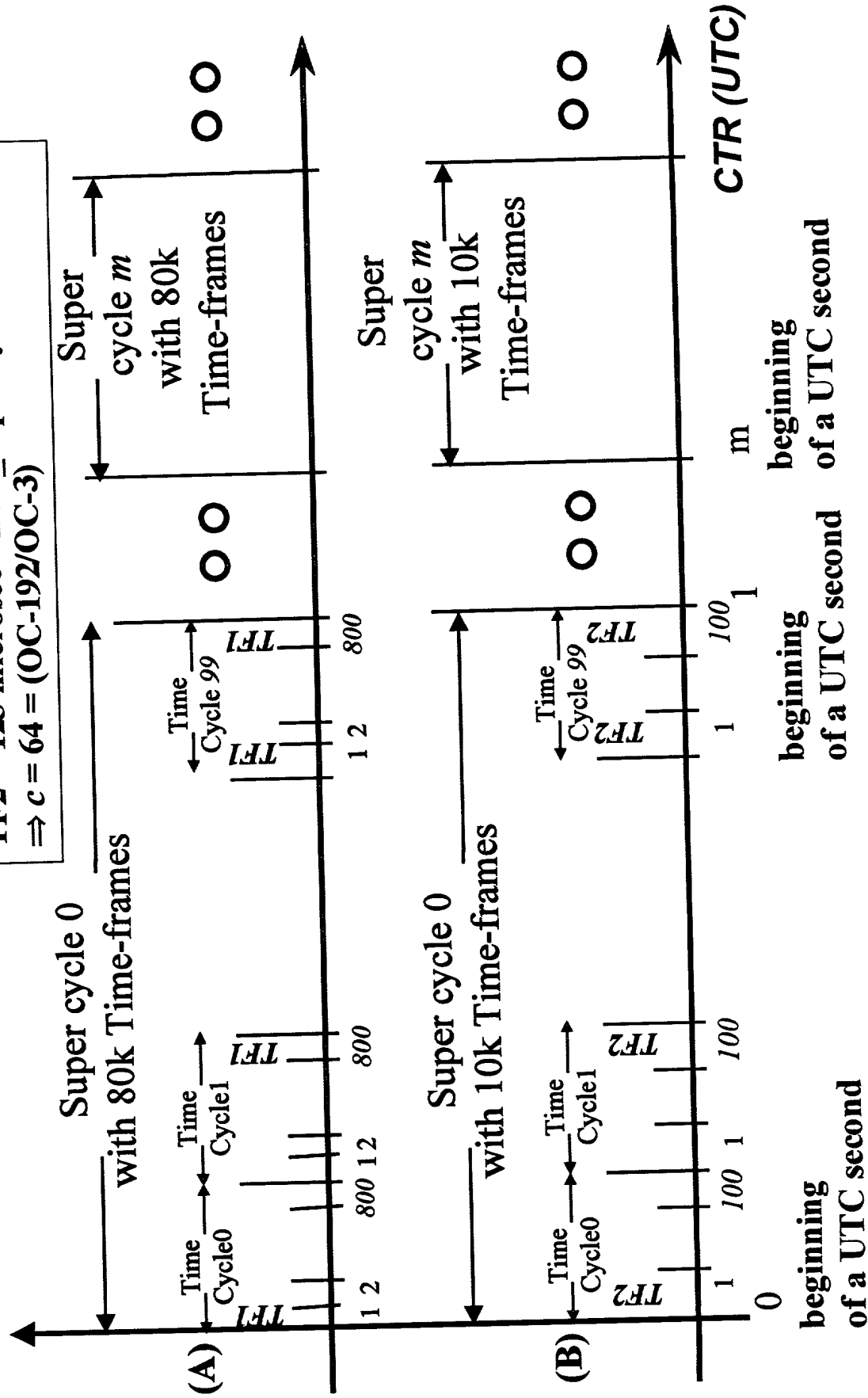


FIG. 3

UTC/CTR™ is used to forward time frames in a synchronized/pipelined manner

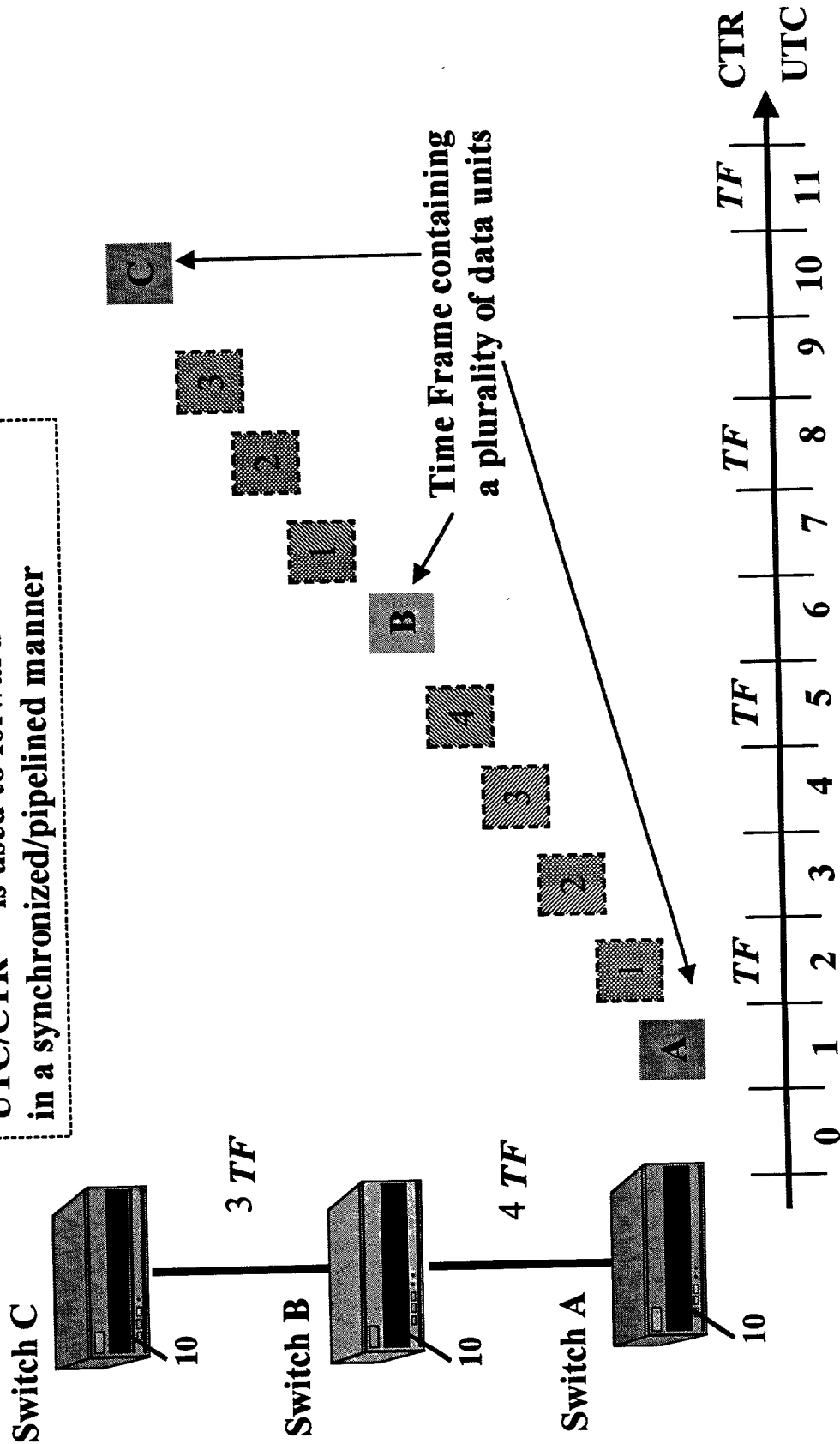


FIG. 4

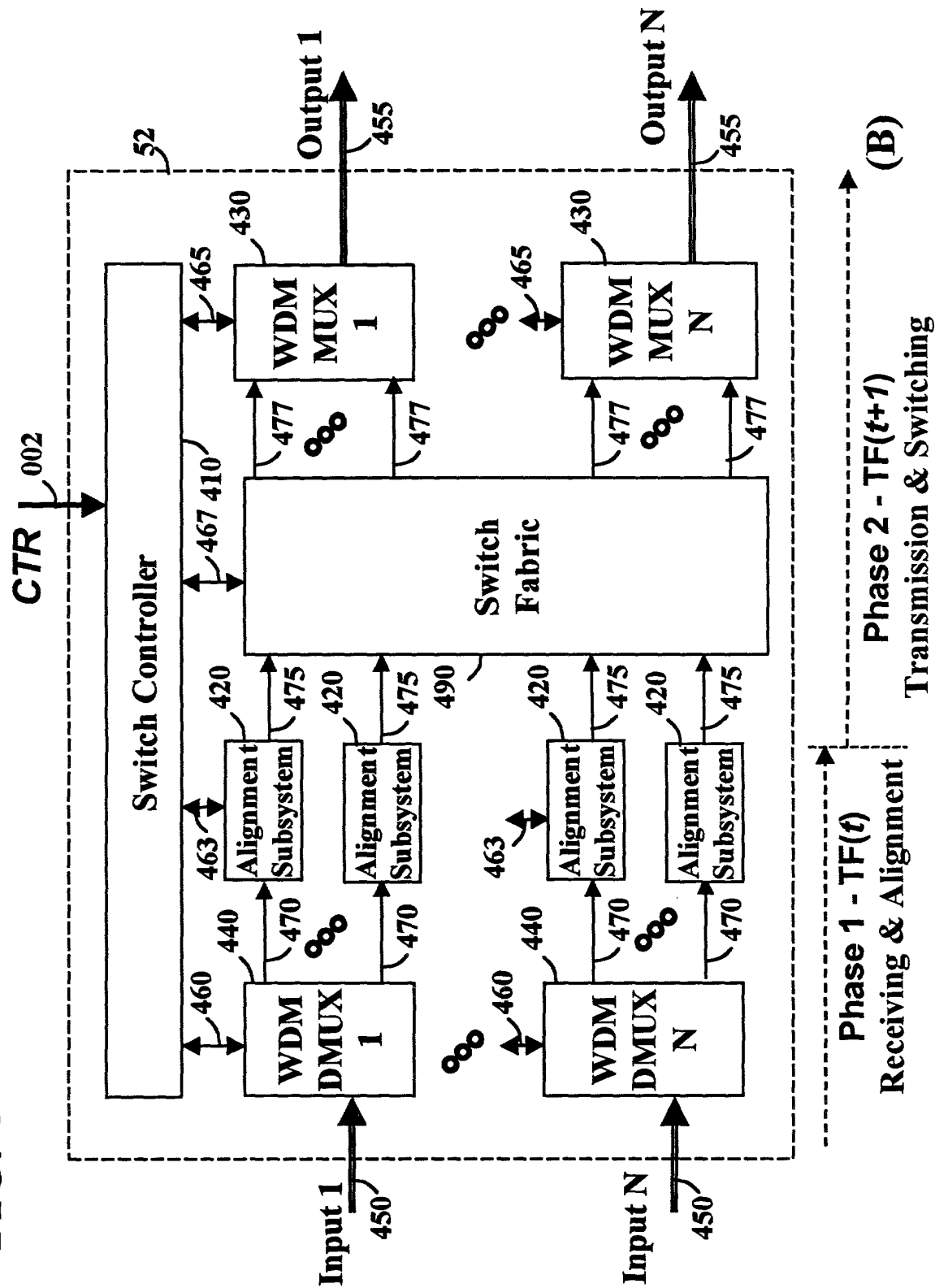


FIG. 5

Two time intervals: $SC1_length \cdot TF1 = 1$ UTC second

- $SC2_length \cdot TF2 = 1$ UTC second
- $TF2 = (SC1_length / SC2_length) \cdot TF1 = k \cdot TF1$, where the time cycles of TF1 and TF2 are aligned with respect to UTC.

For $k = 2$ and $c = 4$ (e.g., High_capacity=OC-192, Low_capacity=OC-48):

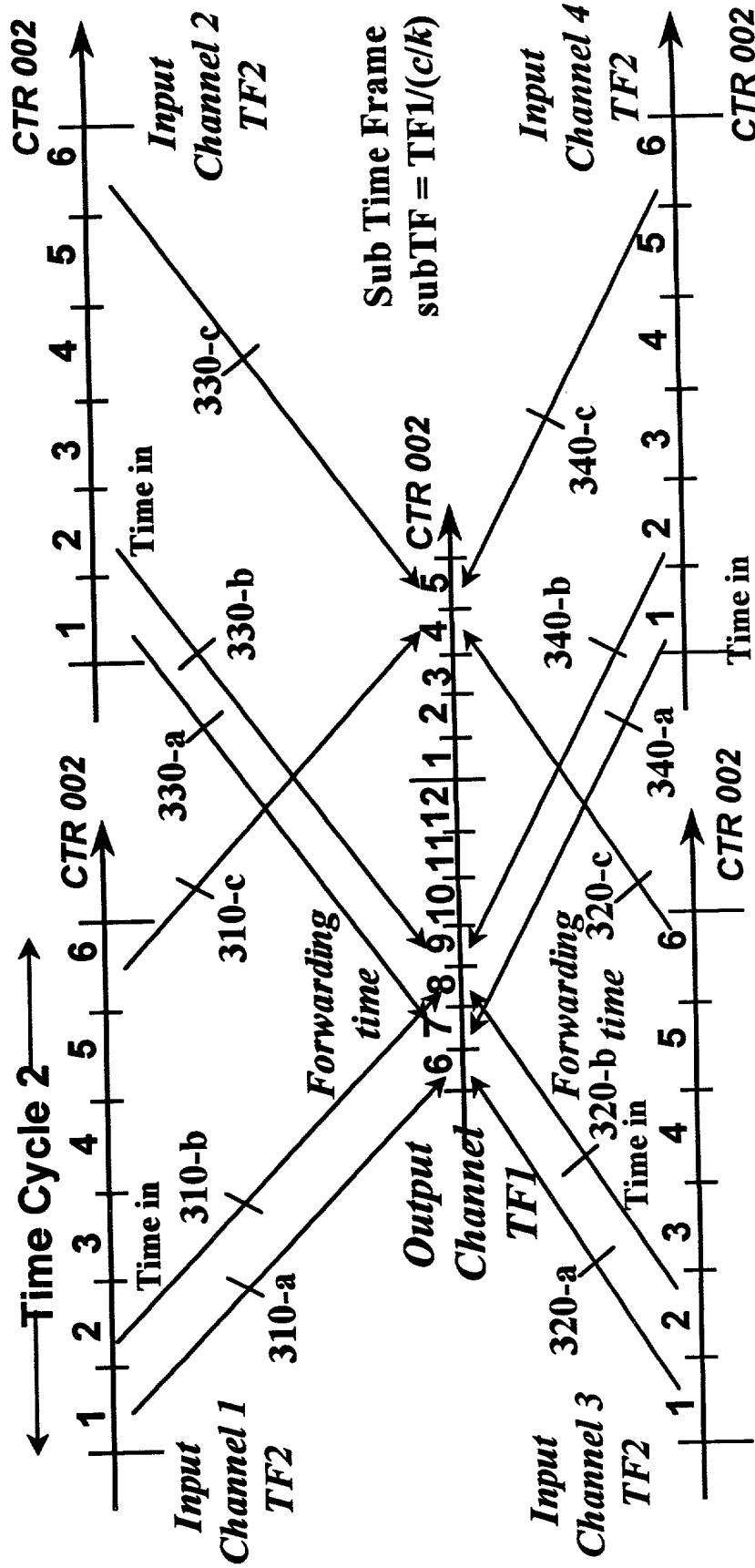


FIG. 6

Two time intervals: $SC1_length \cdot TF1 = 1$ UTC second

- $SC2_length \cdot TF2 = 1$ UTC second
- $TF2 = (SC1_length / SC2_length) \cdot TF1 = k \cdot TF1$, where the time cycles of $TF1$ and $TF2$ are aligned with respect to UTC.

For $k = 2$ and $c = 4$ (e.g., High_capacity=OC-192, Low_capacity=OC-48):

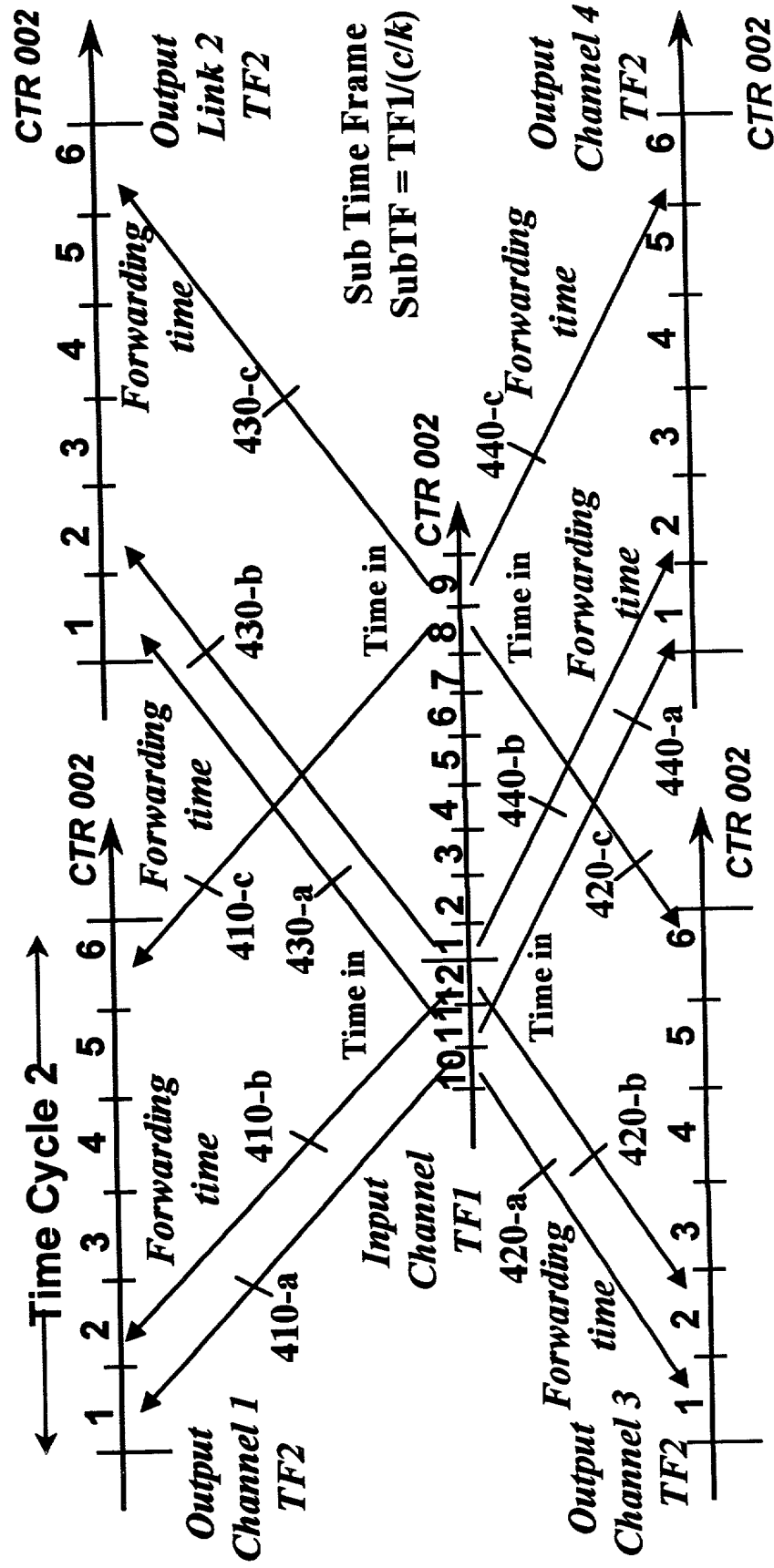


FIG. 7

Two time intervals: $SC1_length \cdot TF1 = 1$ UTC second

- $SC2_length \cdot TF2 = 1$ UTC second
 - $TF2 = (SC1_length / SC2_length) \cdot TF1 = k \cdot TF1$, where the time cycles of $TF1$ and $TF2$ are aligned with respect to UTC.
- For $k = 2$ and $c = 4$ (e.g., High_capacity=OC-192, Low_capacity=OC-48):

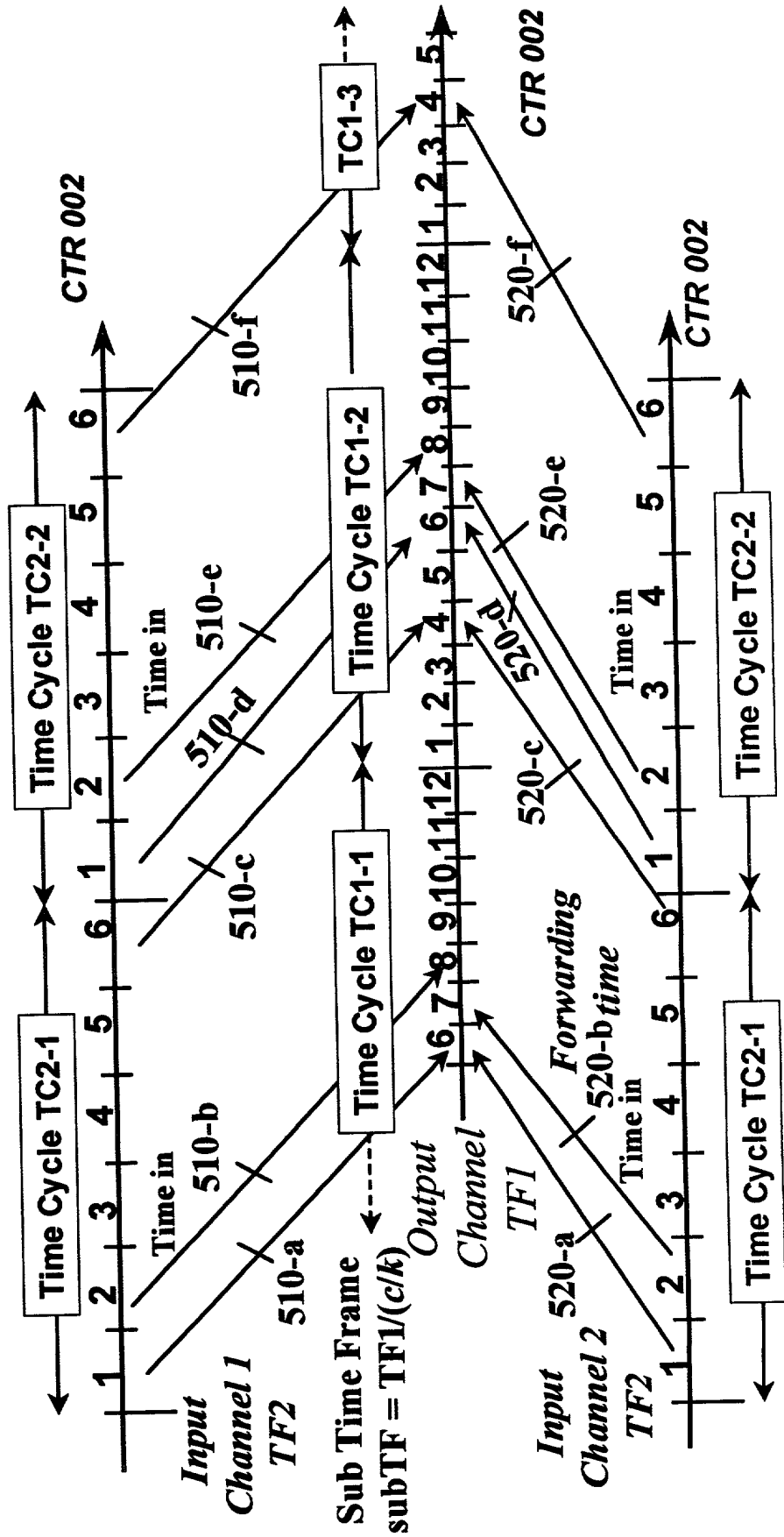
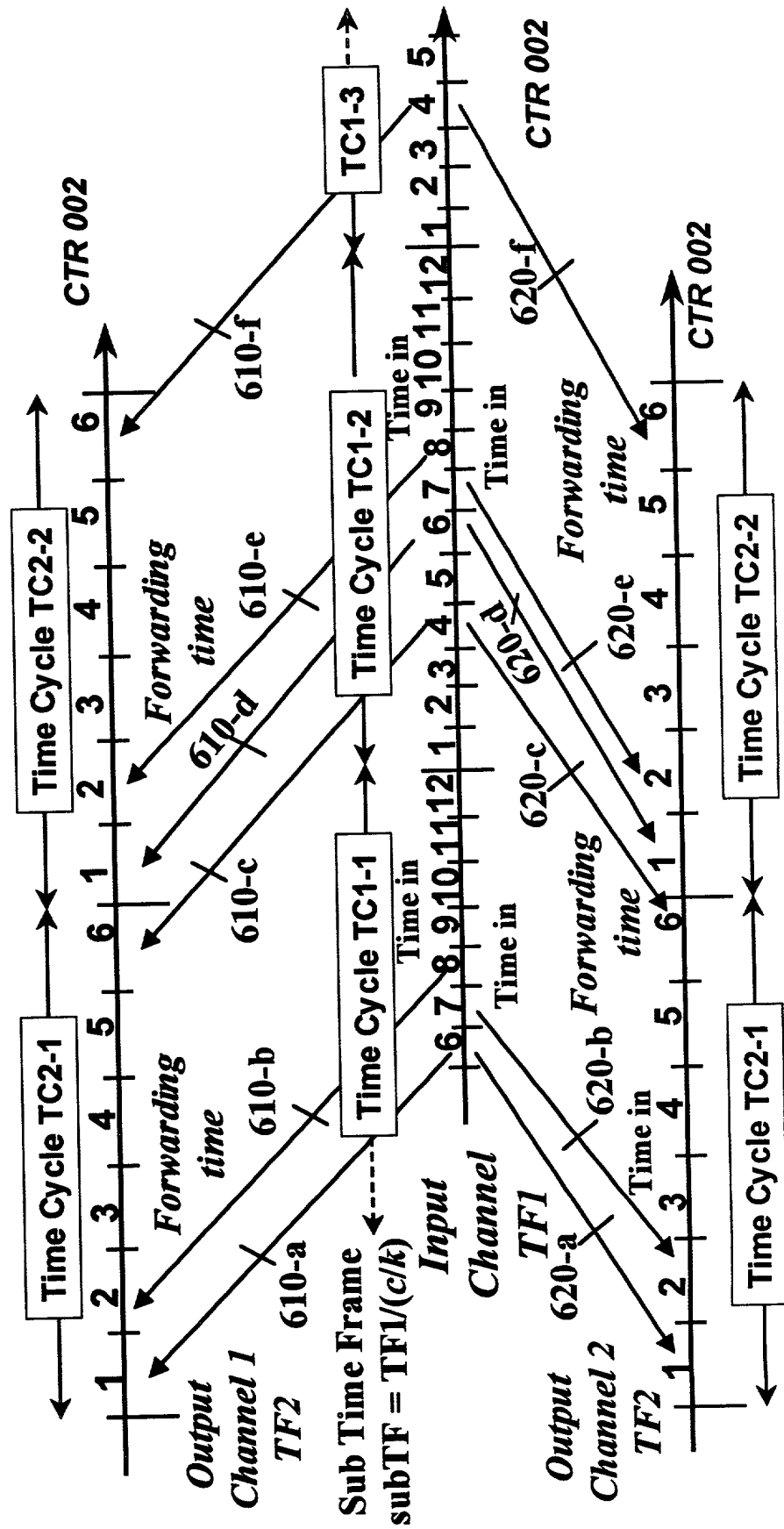


FIG. 8

Two time intervals: $SC1_length \cdot TF1 = 1$ UTC second

- $SC2_length \cdot TF2 = 1$ UTC second
- $TF2 = (SC1_length / SC2_length) \cdot TF1 = k \cdot TF1$, where the time cycles of $TF1$ and $TF2$ are aligned with respect to UTC.

For $k = 2$ and $c = 4$ (e.g., High_capacity=OC-192, Low_capacity=OC-48):



$c=4$, e.g., OC-192/OC-48
 $k=2$, e.g., 25 microsec/12.5 microsec

FIG. 9

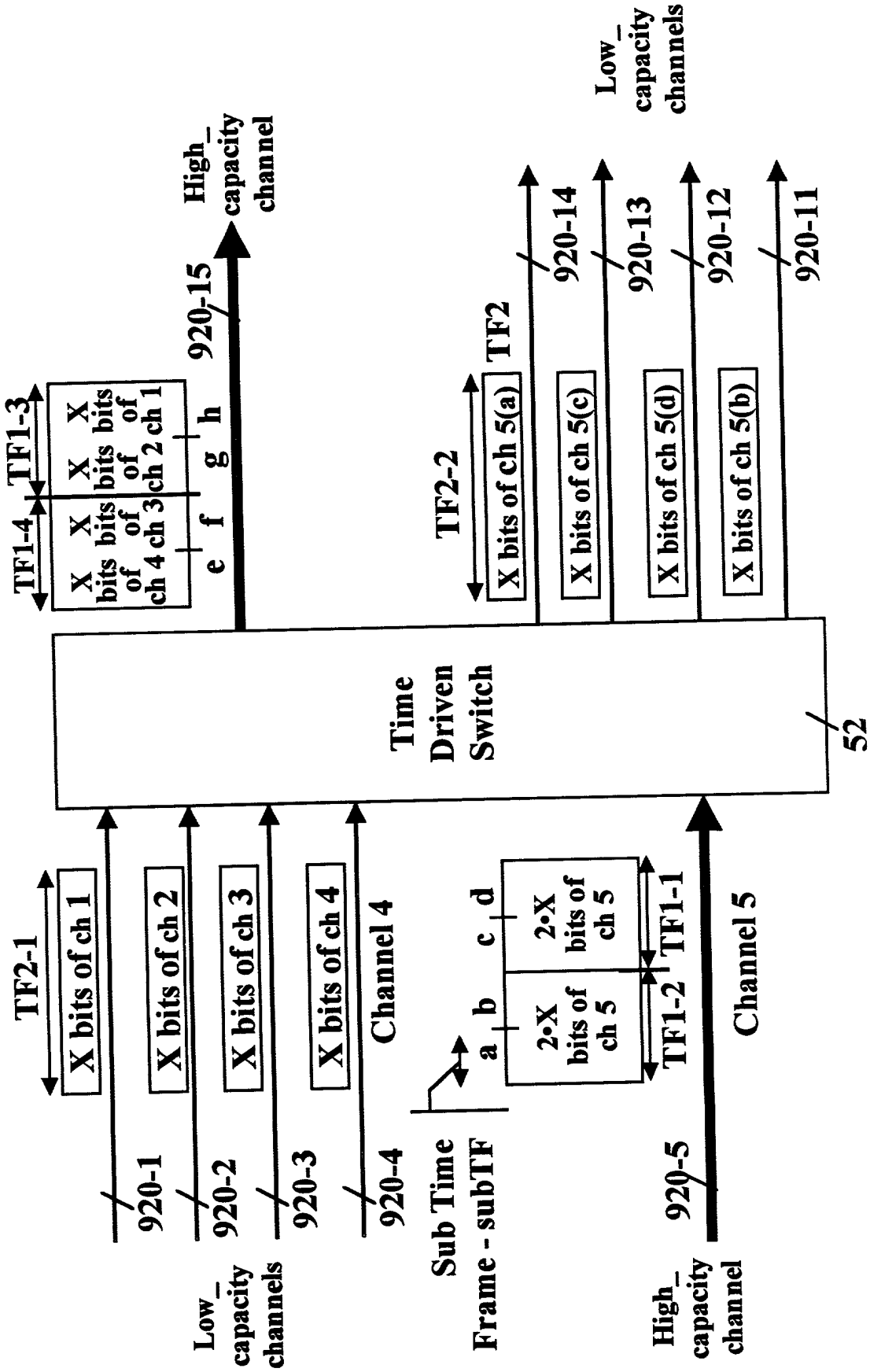


FIG. 10

$c=4$, e.g., OC-192/OC-48
 $k=2$, e.g., 25 microsec/12.5 microsec

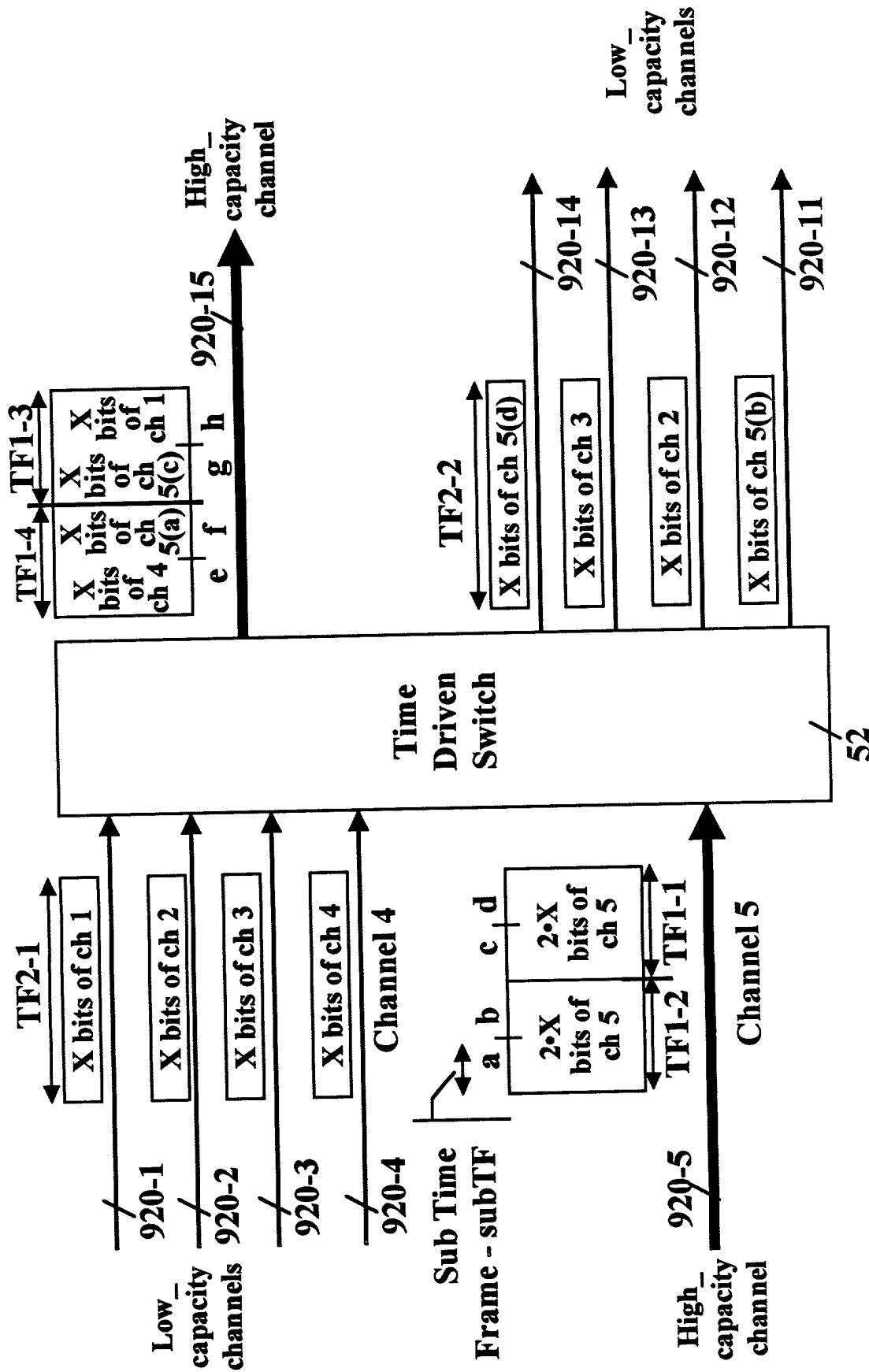


FIG. 11

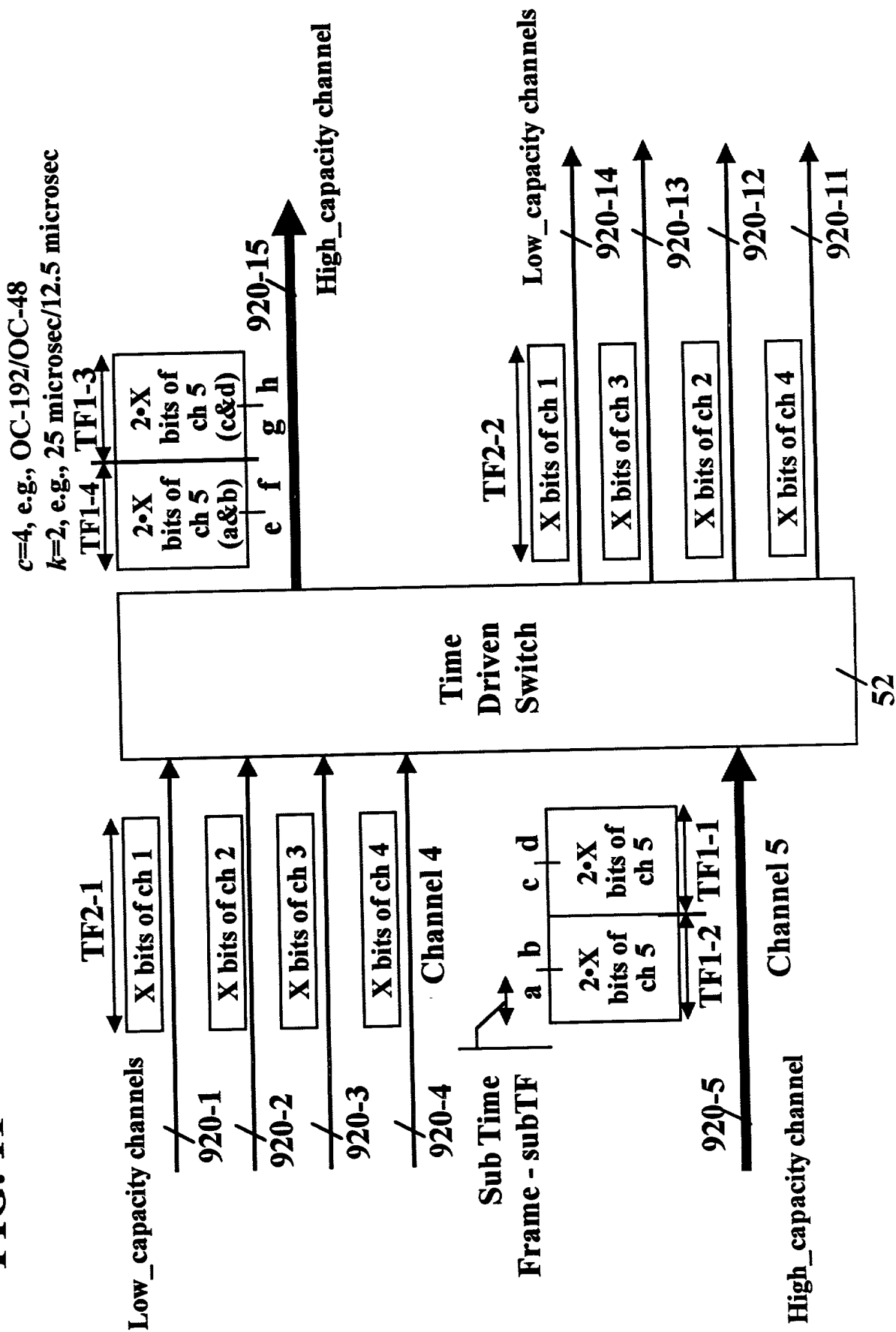


FIG. 12

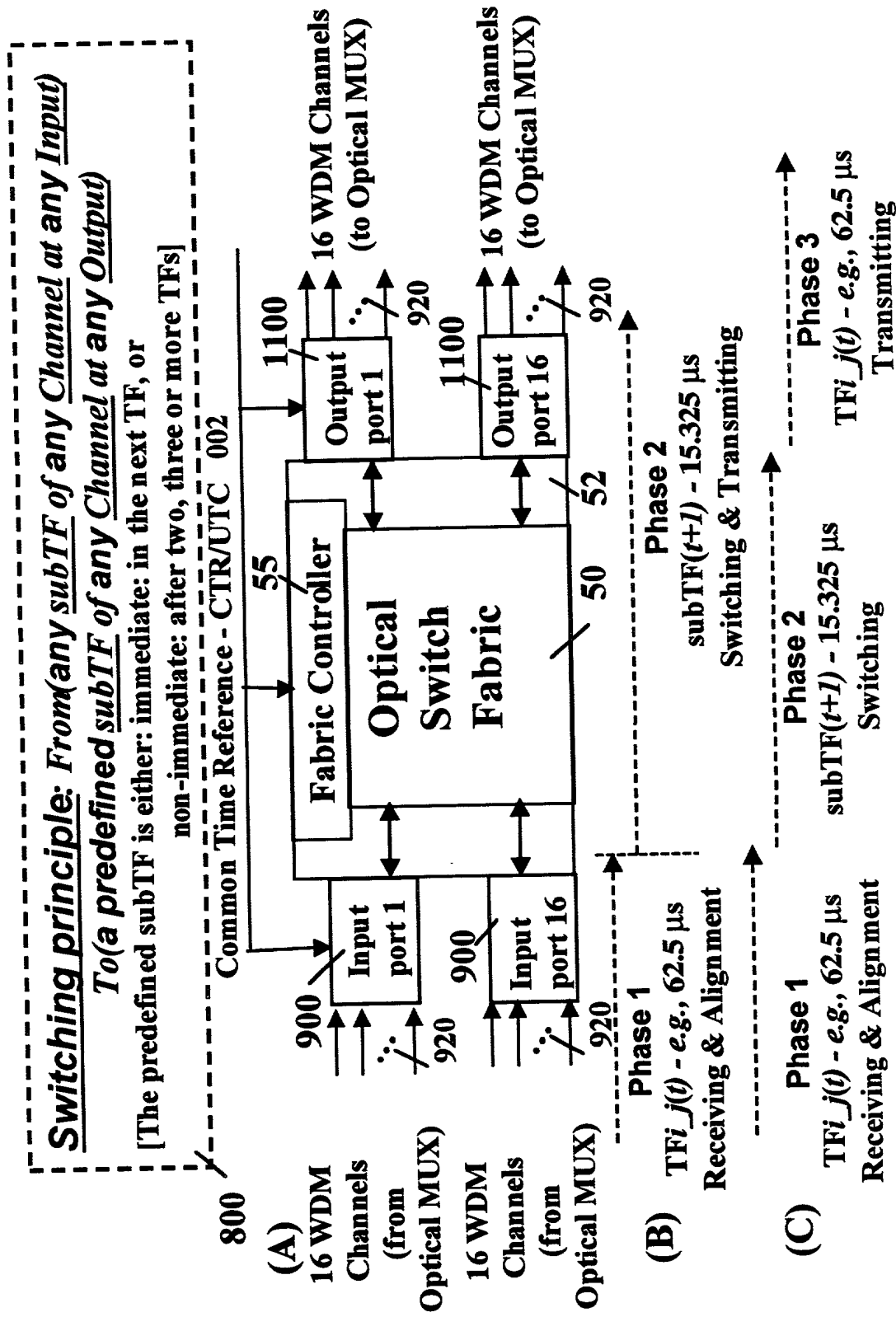


FIG. 13

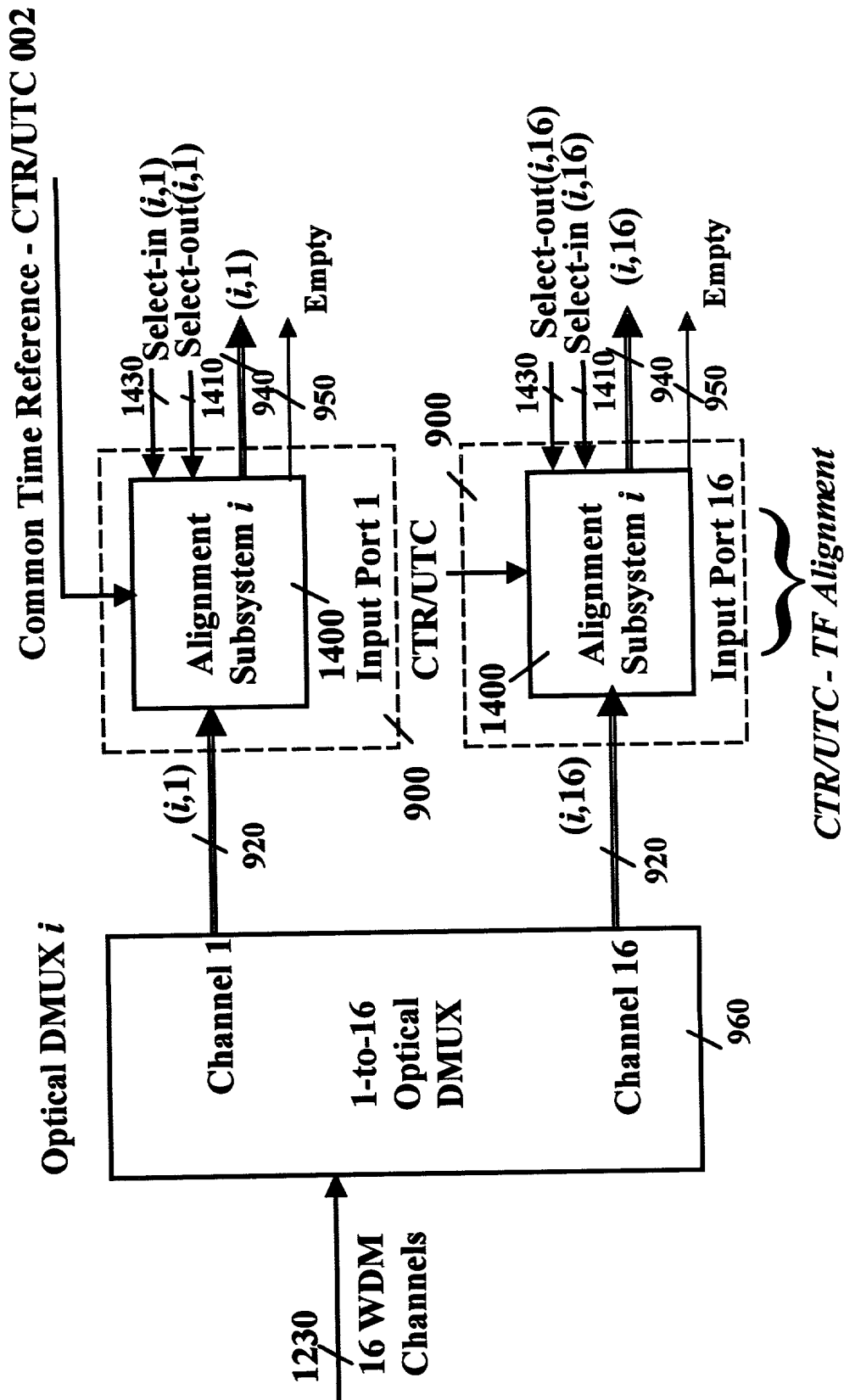


FIG. 14

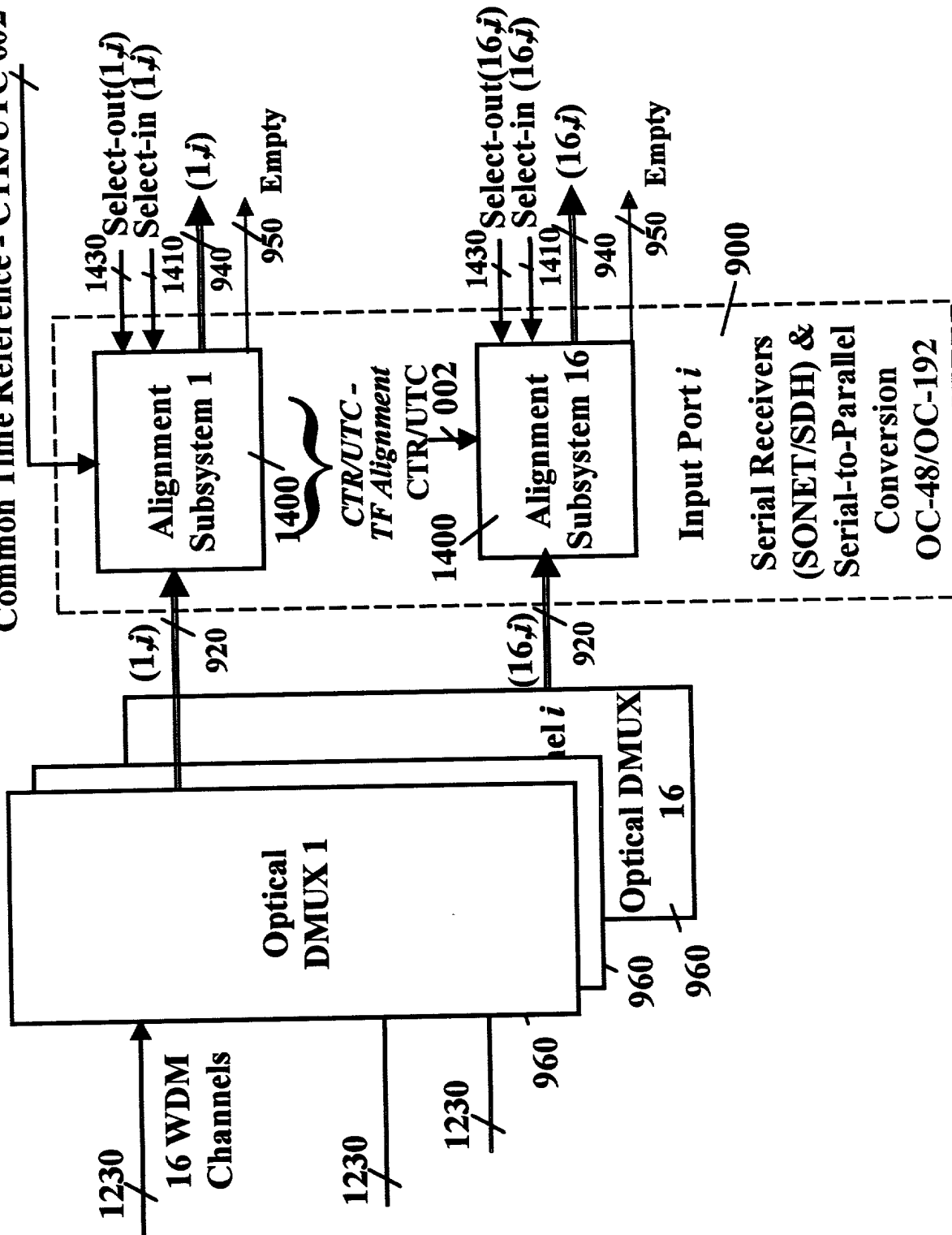


FIG. 15

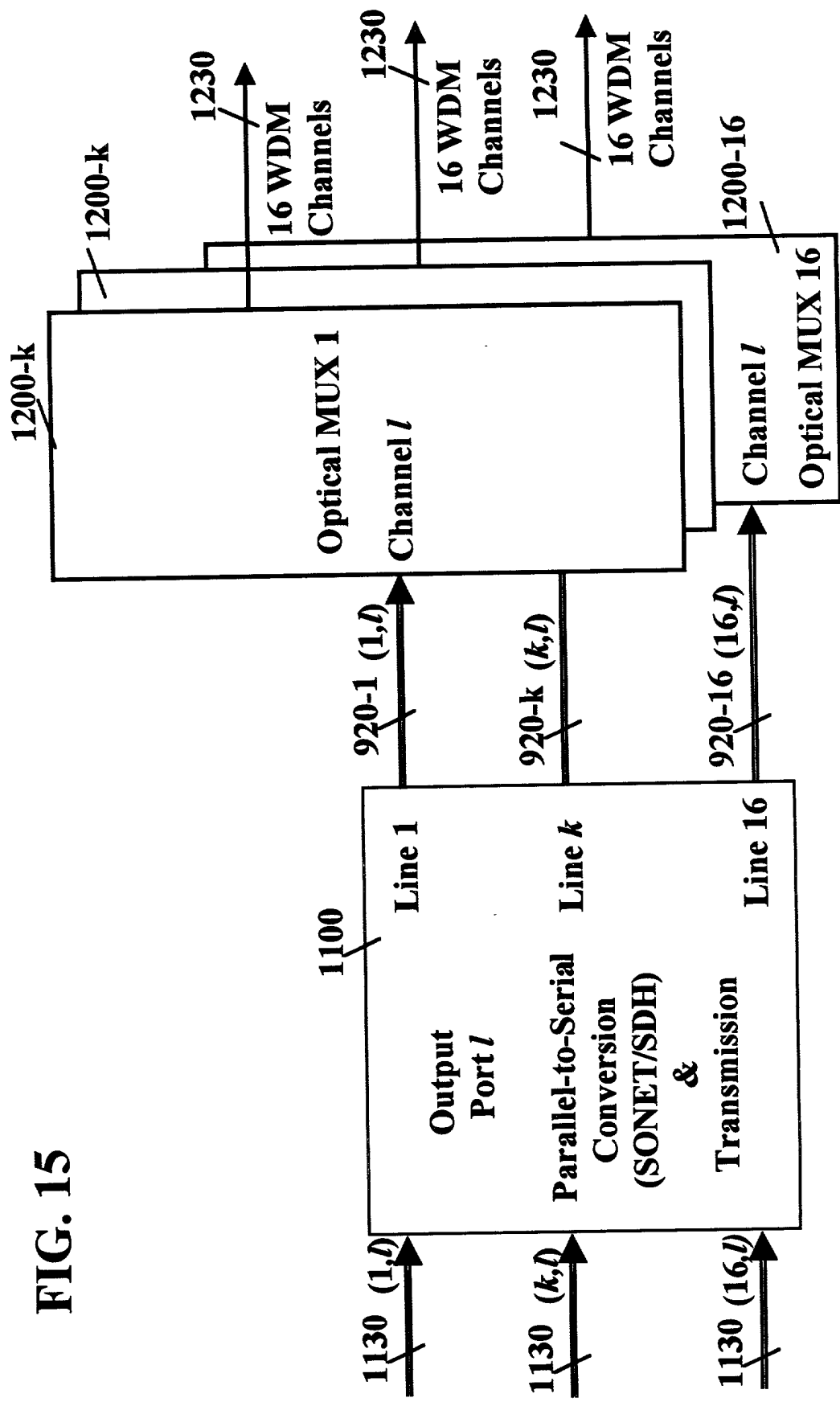


FIG. 16

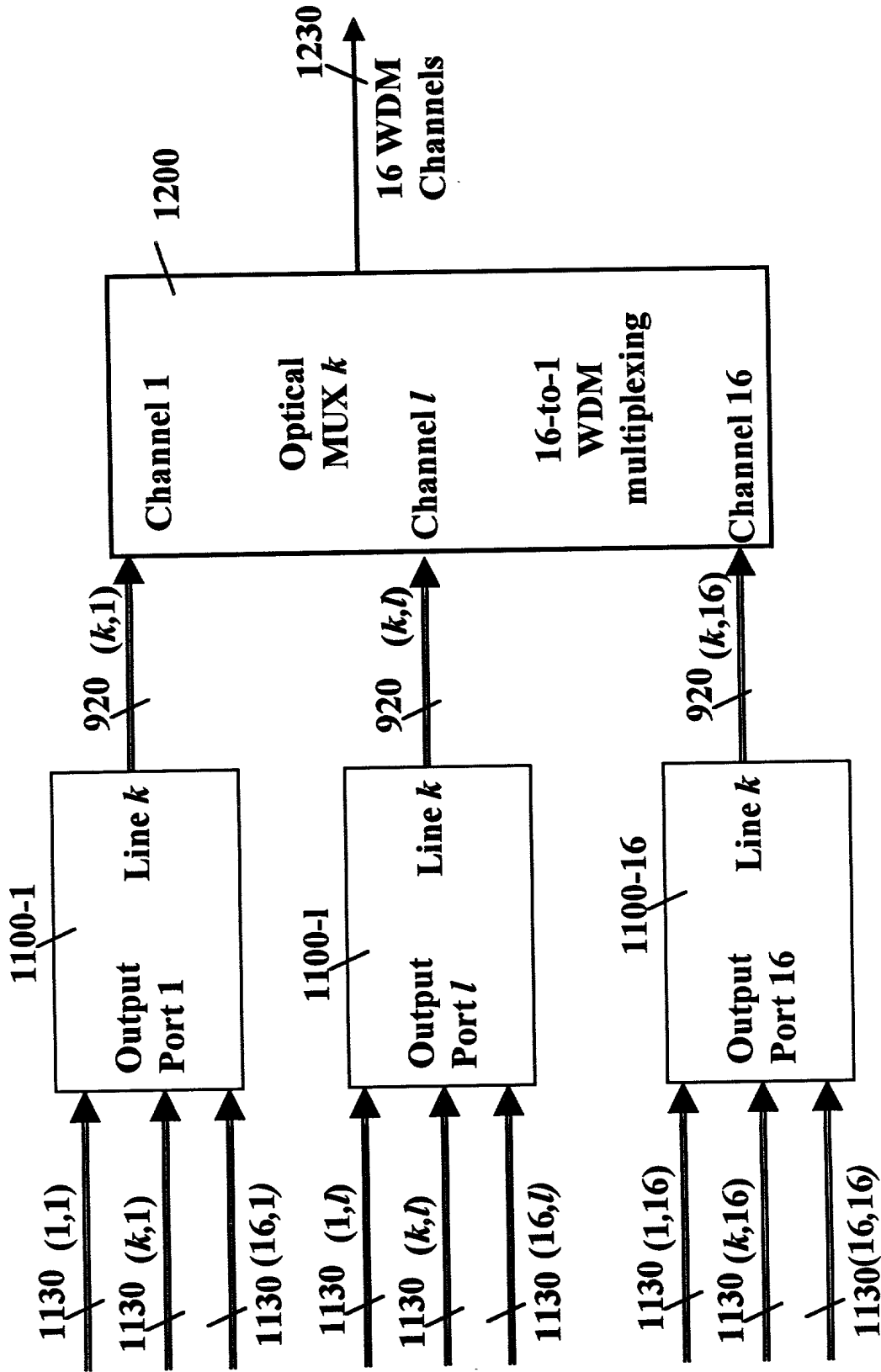


FIG. 17 N: number of input/output channels. E.g., N=256

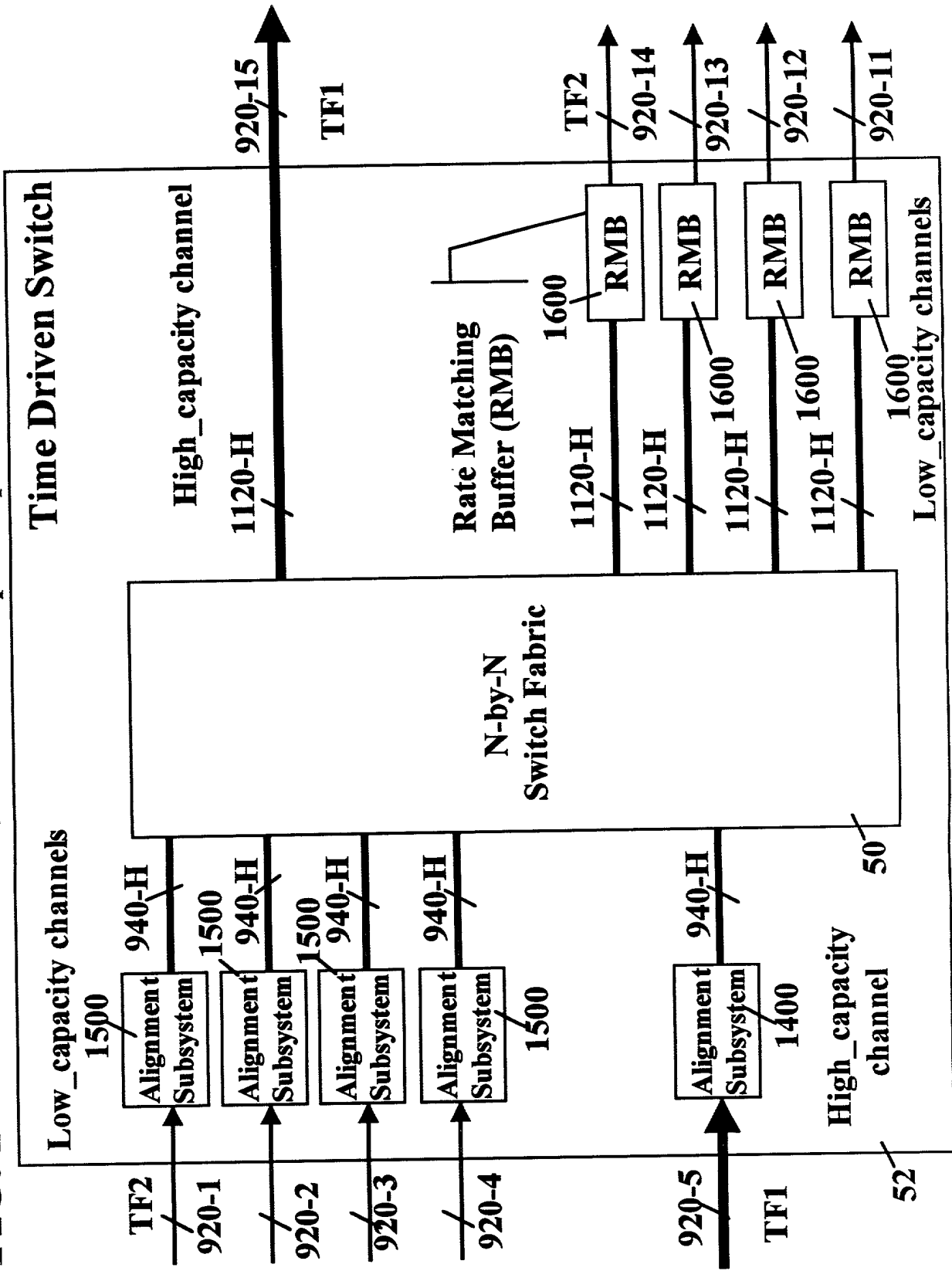
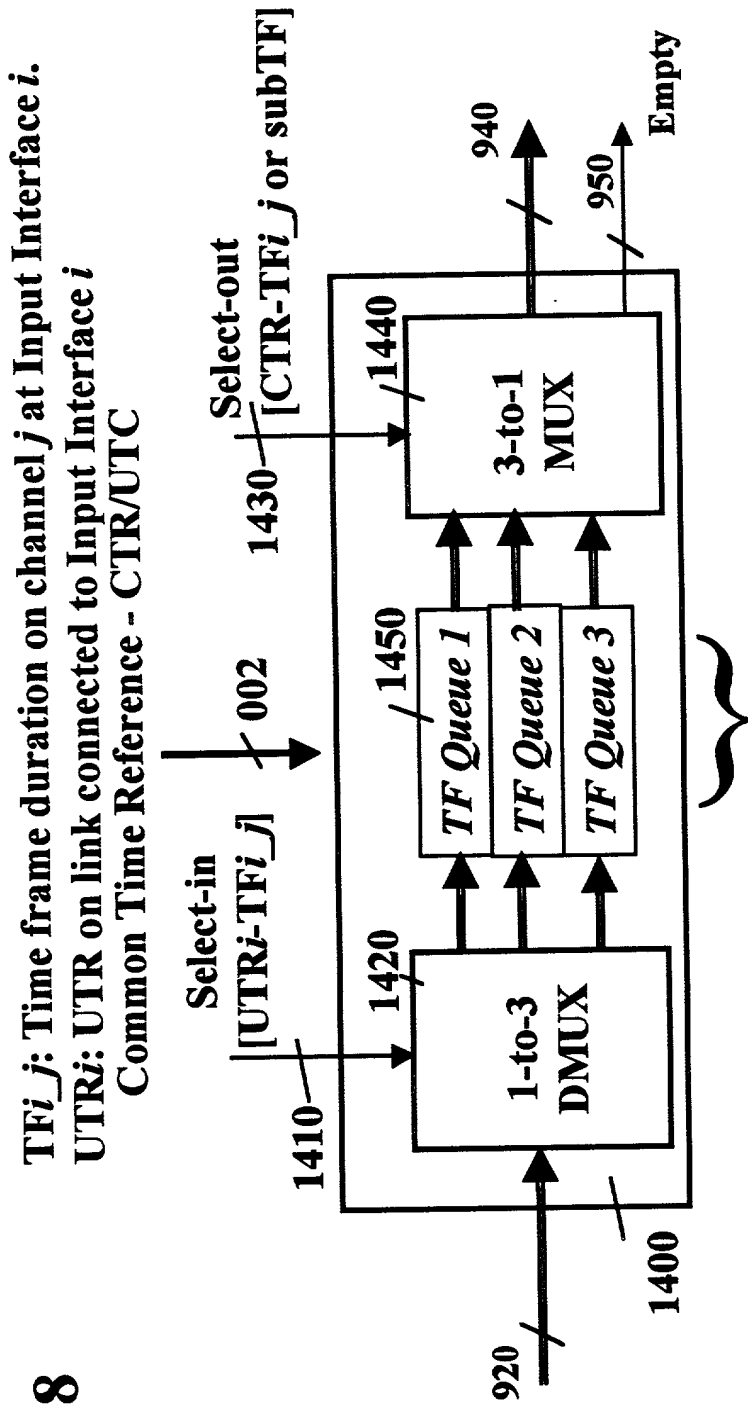


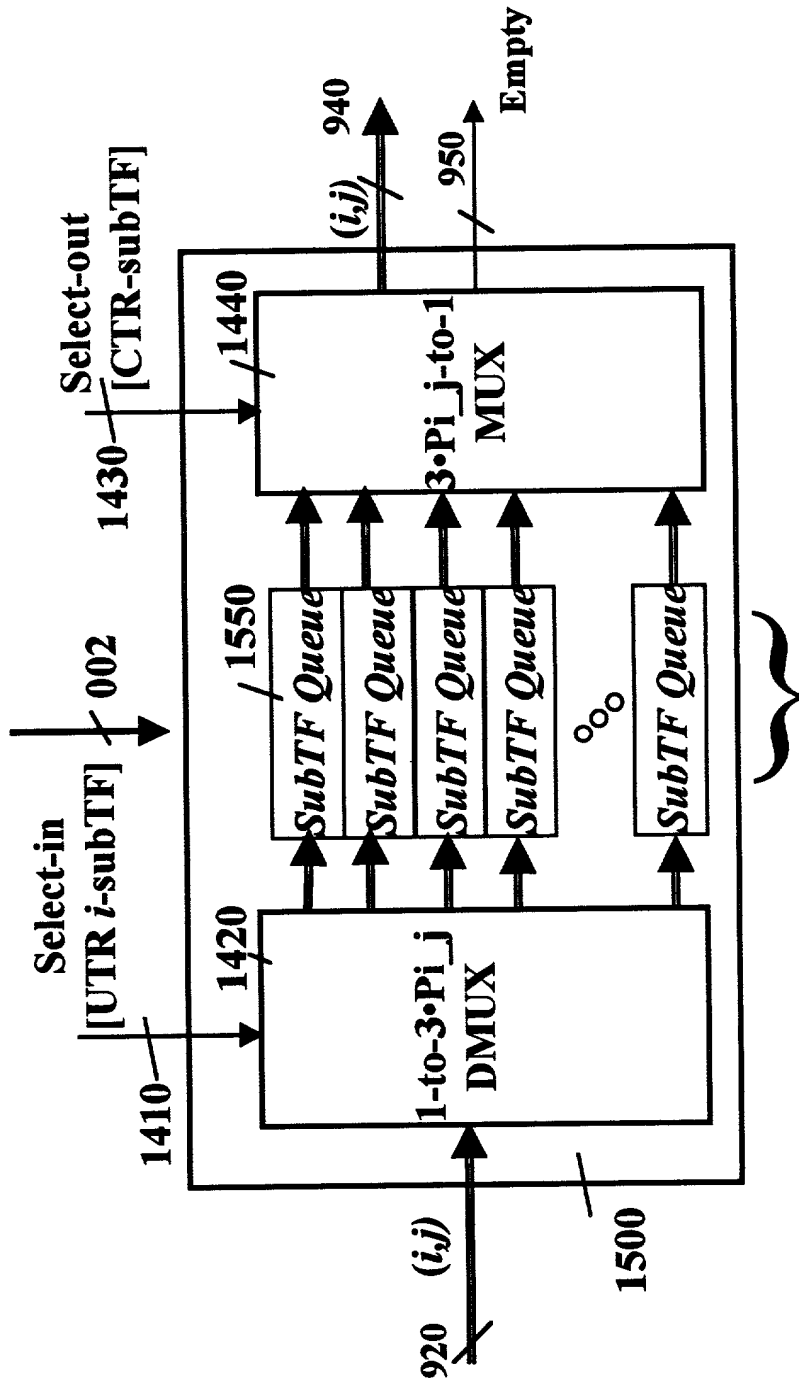
FIG. 18



Alignment Subsystem for Channel *j* at Input Interface *i*
with a Plurality of Time Frame Queues

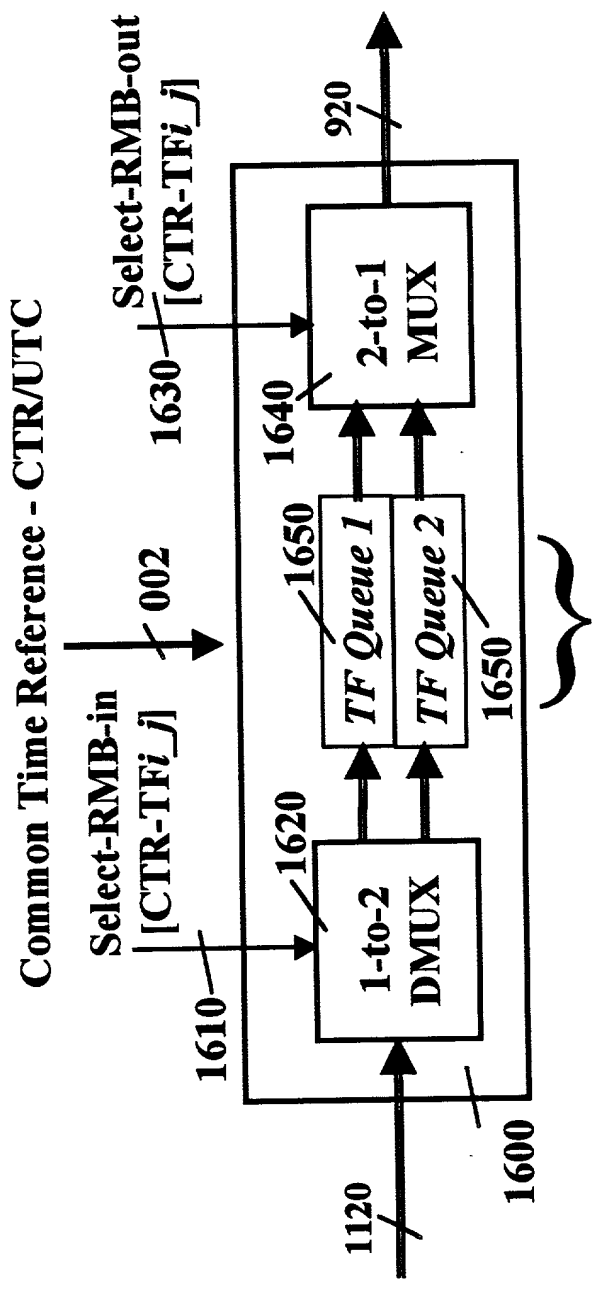
TF_{i,j}: Time frame duration on channel *j* at Input Interface *i*.
 UTR *i*: UTR on link connected to Input Interface *i*
 P_{i,j} = TF_{i,j}/subTF

Common Time Reference - CTR/UTC

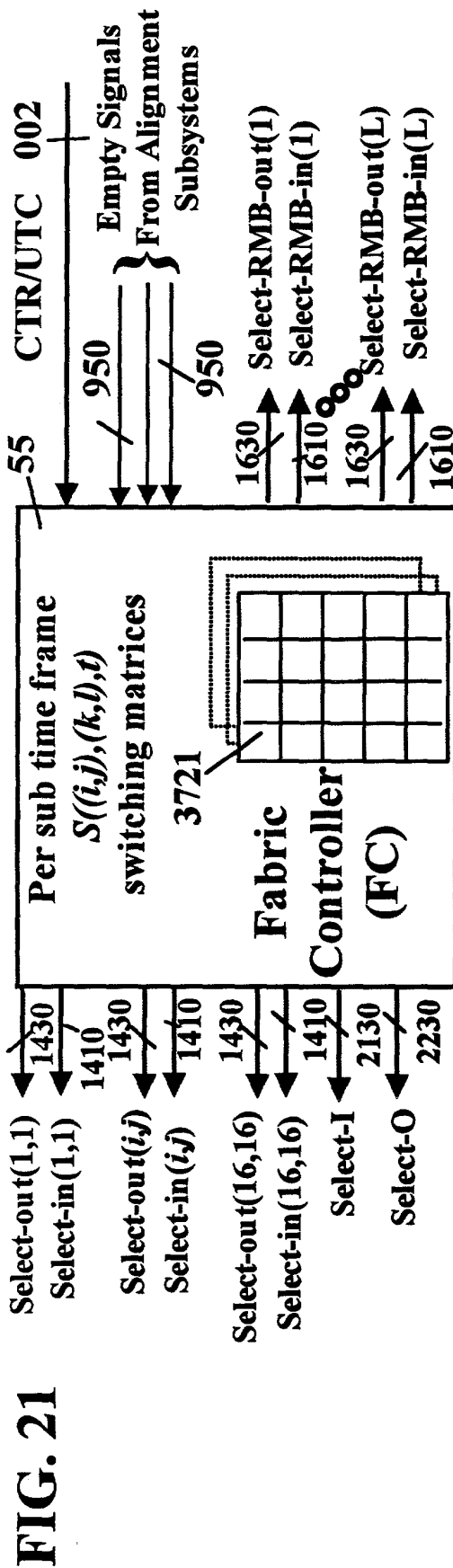


Alignment Subsystem for high capacity Channel *j* at Input Interface *i*
 with a Plurality of Sub-Time Frame Queues

FIG. 18+2 TFi_j : Time frame duration on channel j at Input Interface i .
 UTR i : UTR on link connected to Input Interface i



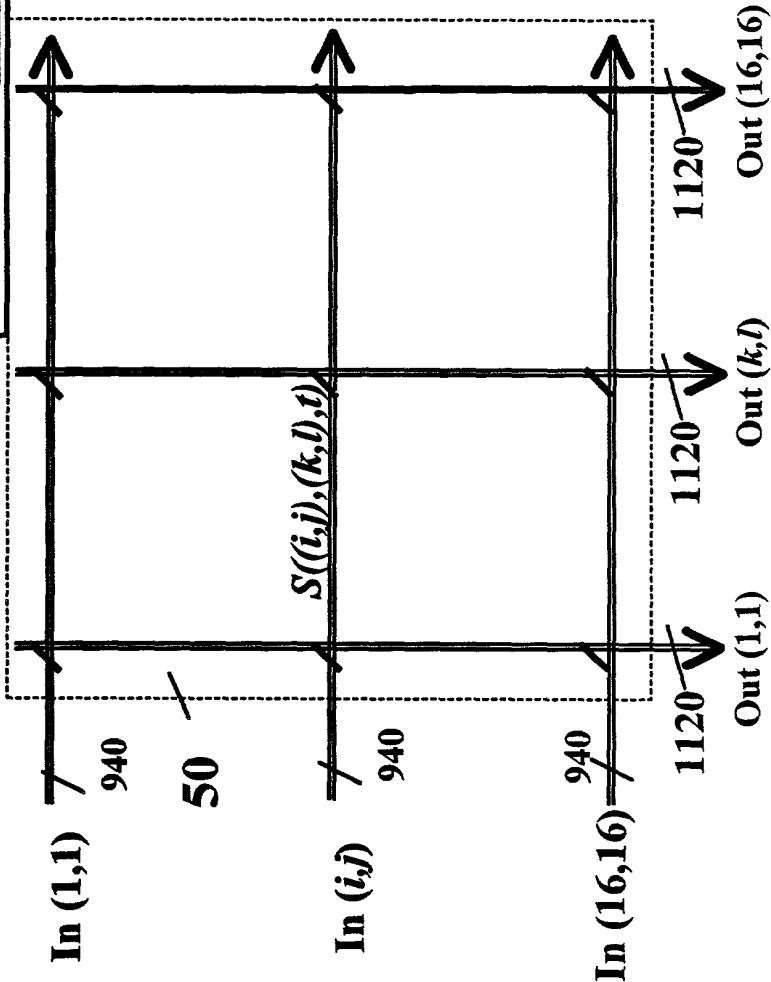
Rate Matching Buffer for Channel j at Output Interface i
with a Plurality of Time Frame Queues
 (Also single buffer with dual access memory with single phase switching and forwarding)



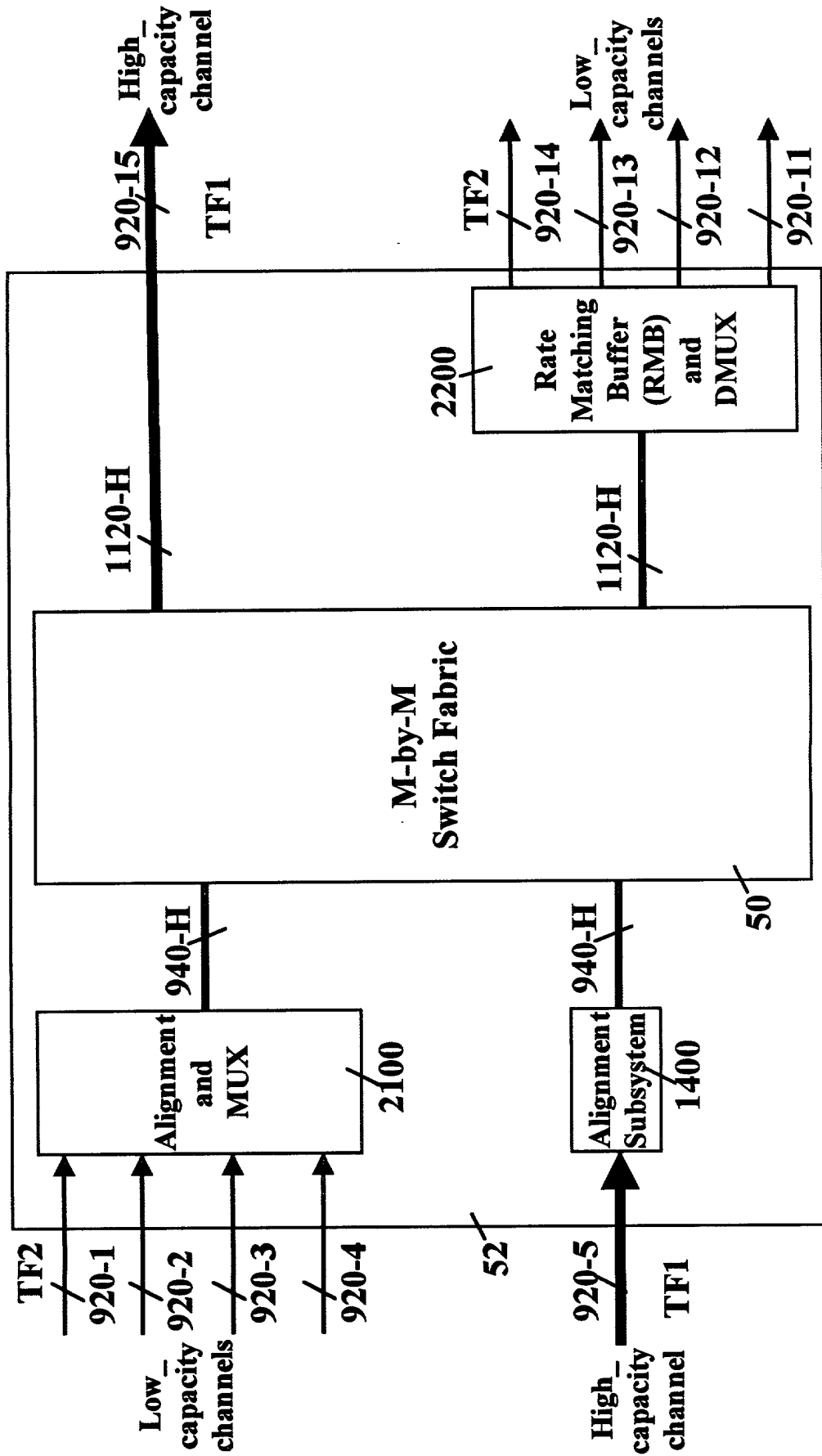
Fabric controller (FC):
 $S((i,j),(k,l),t)$ - switching matrix for every sub-time frame in each time cycle and super cycle.

The matrix defines which input channel i,j should be connected to output channel k,l - in sub time frame t , where $S((i,j),(k,l),t)=1$:

1. At every sub-time frame an input channel can be connected to one or more output optical channels (multicast - MCST)
2. At every sub-time frame an output optical channel can be connected to at most one input optical channel

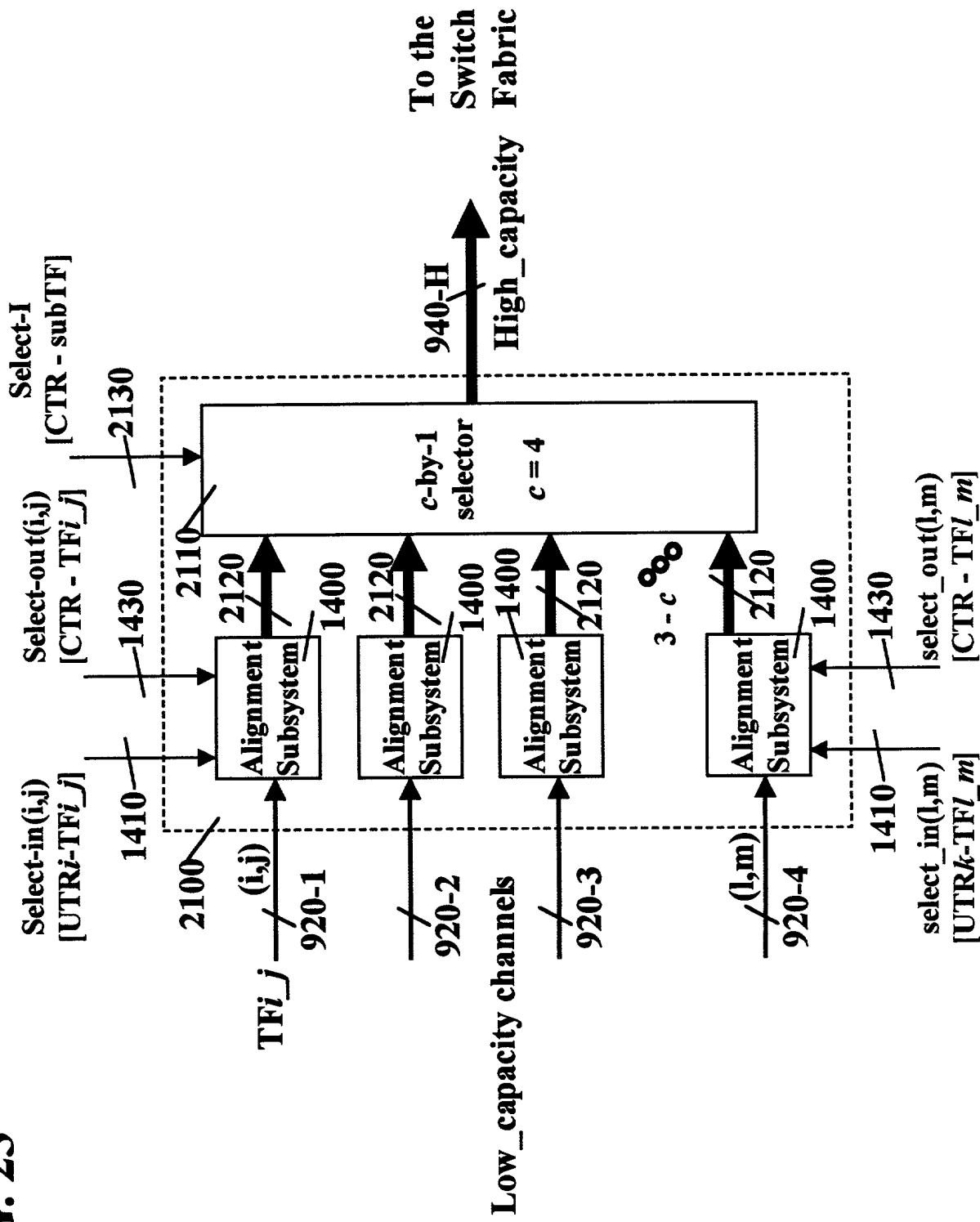


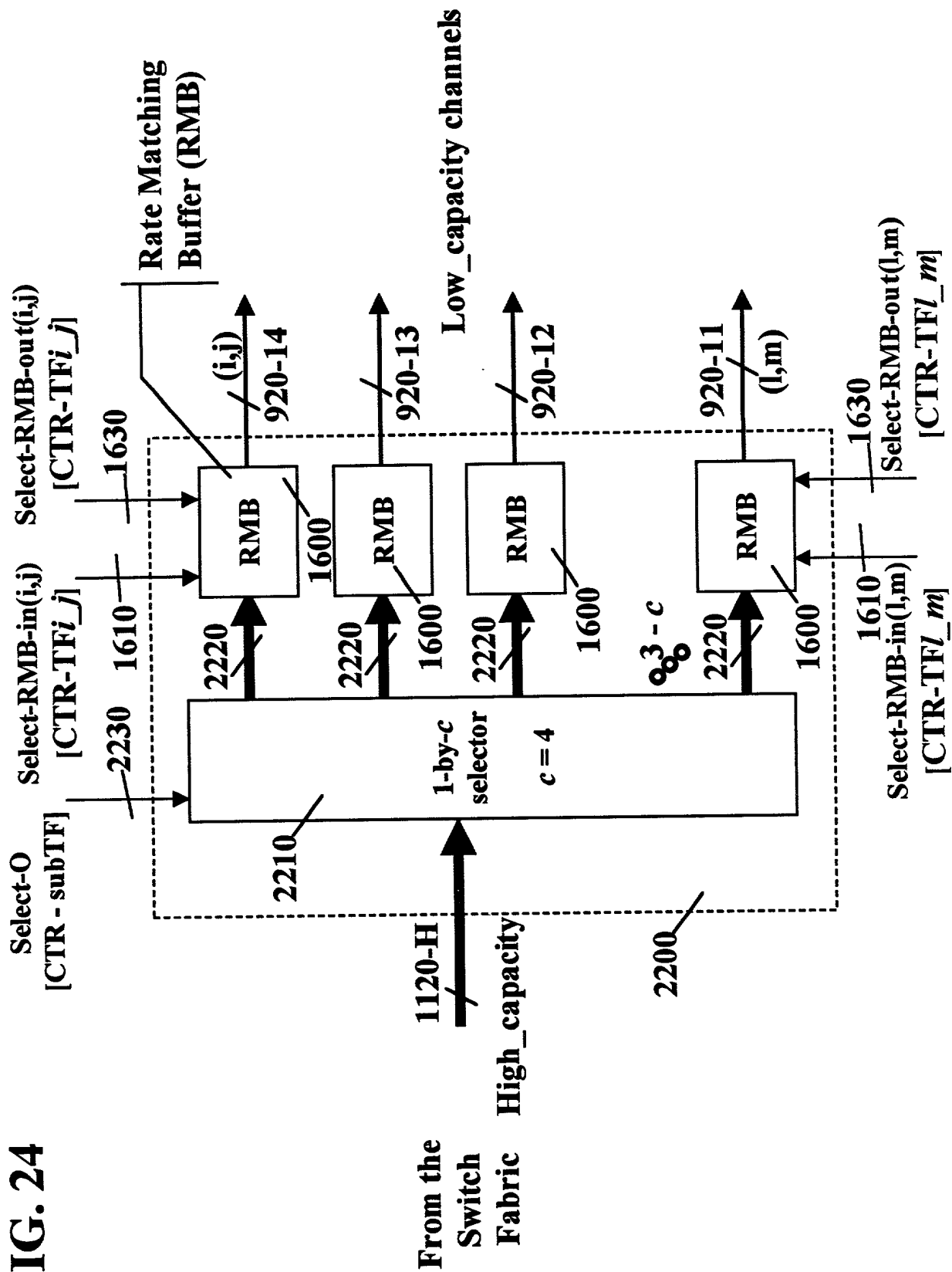
N: number of input/output channels. E.g., N=256
 $M \cdot \text{High_capacity} = N_{\text{high}} \cdot \text{High_capacity} + N_{\text{low}} \cdot \text{Low_capacity}$
 $M < N$



Time Driven Switch

FIG. 23



[illegible]

N: number of input/output channels. E.g., $N=256$
 $L \cdot \text{Low_capacity} = N_{\text{high}} \cdot \text{High_capacity} + N_{\text{low}} \cdot \text{Low_capacity}$
 $L > N$

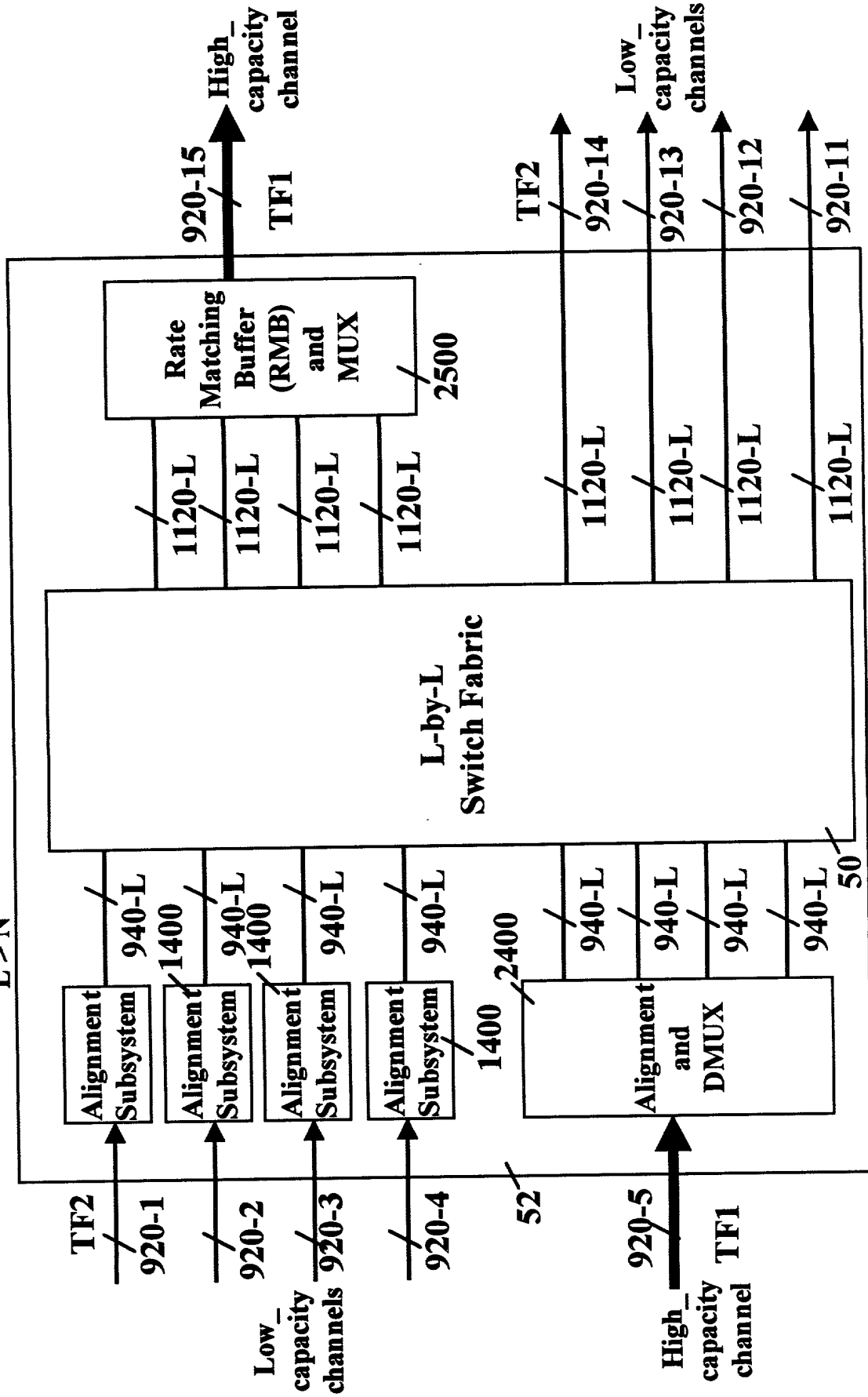
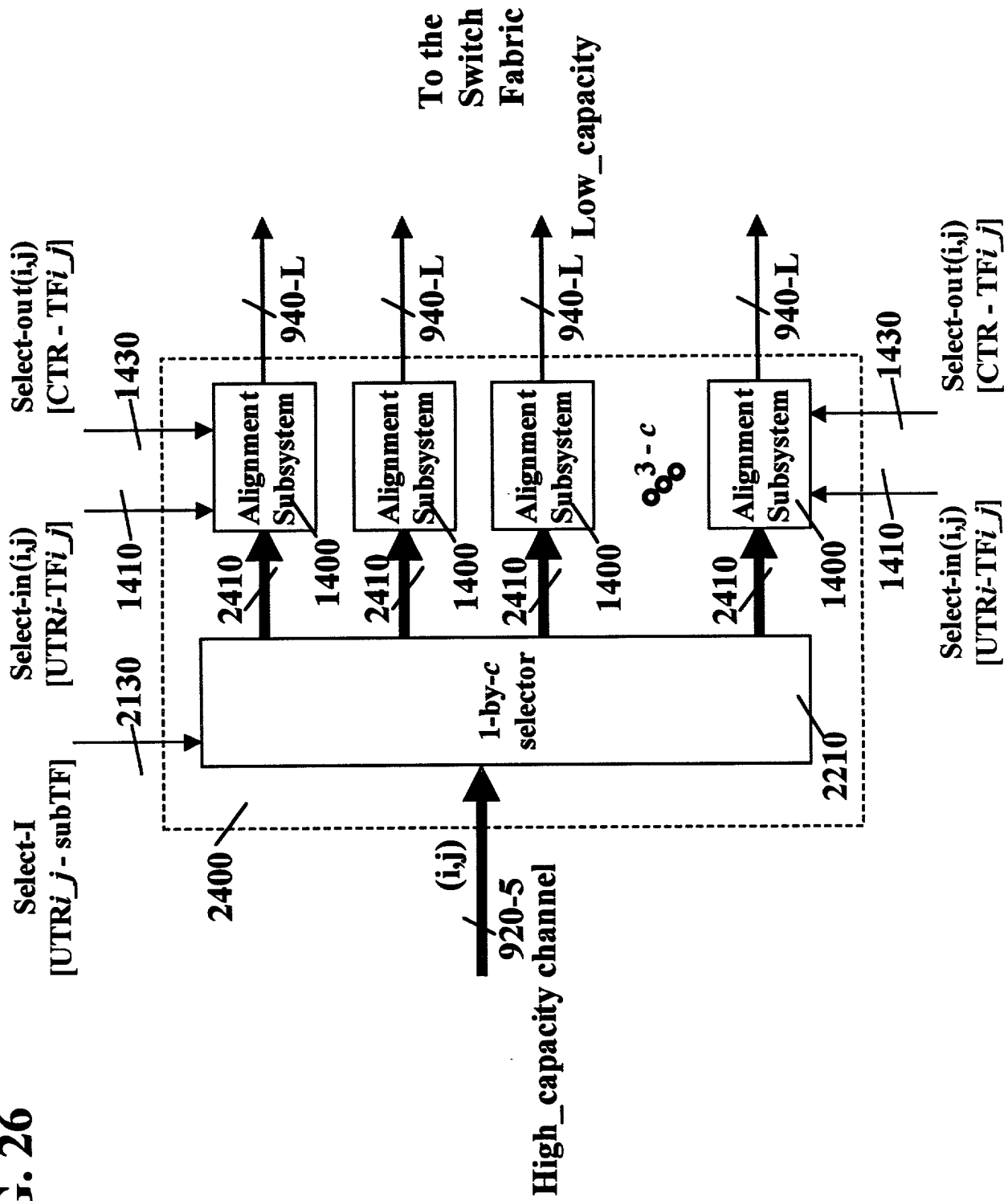


FIG. 26



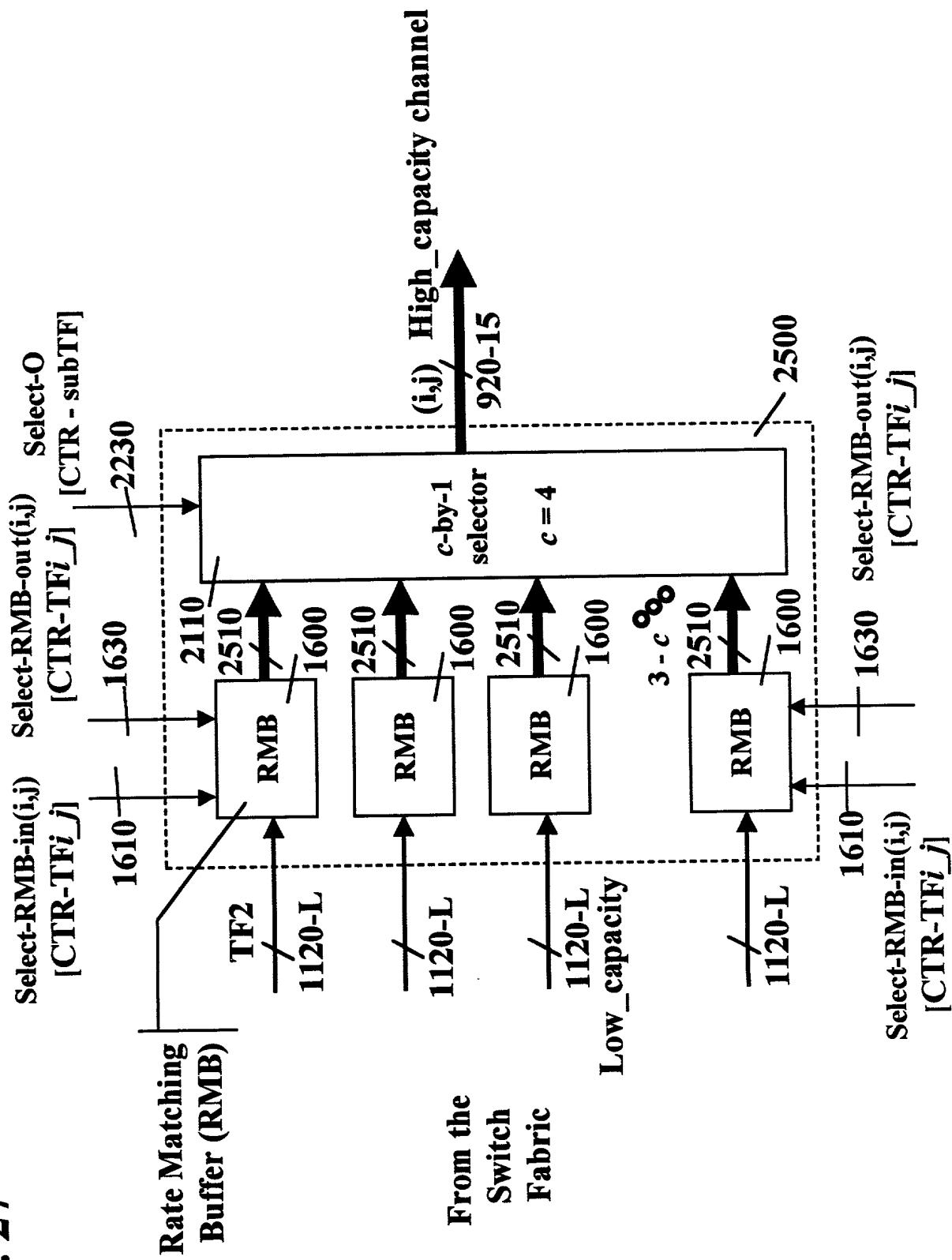
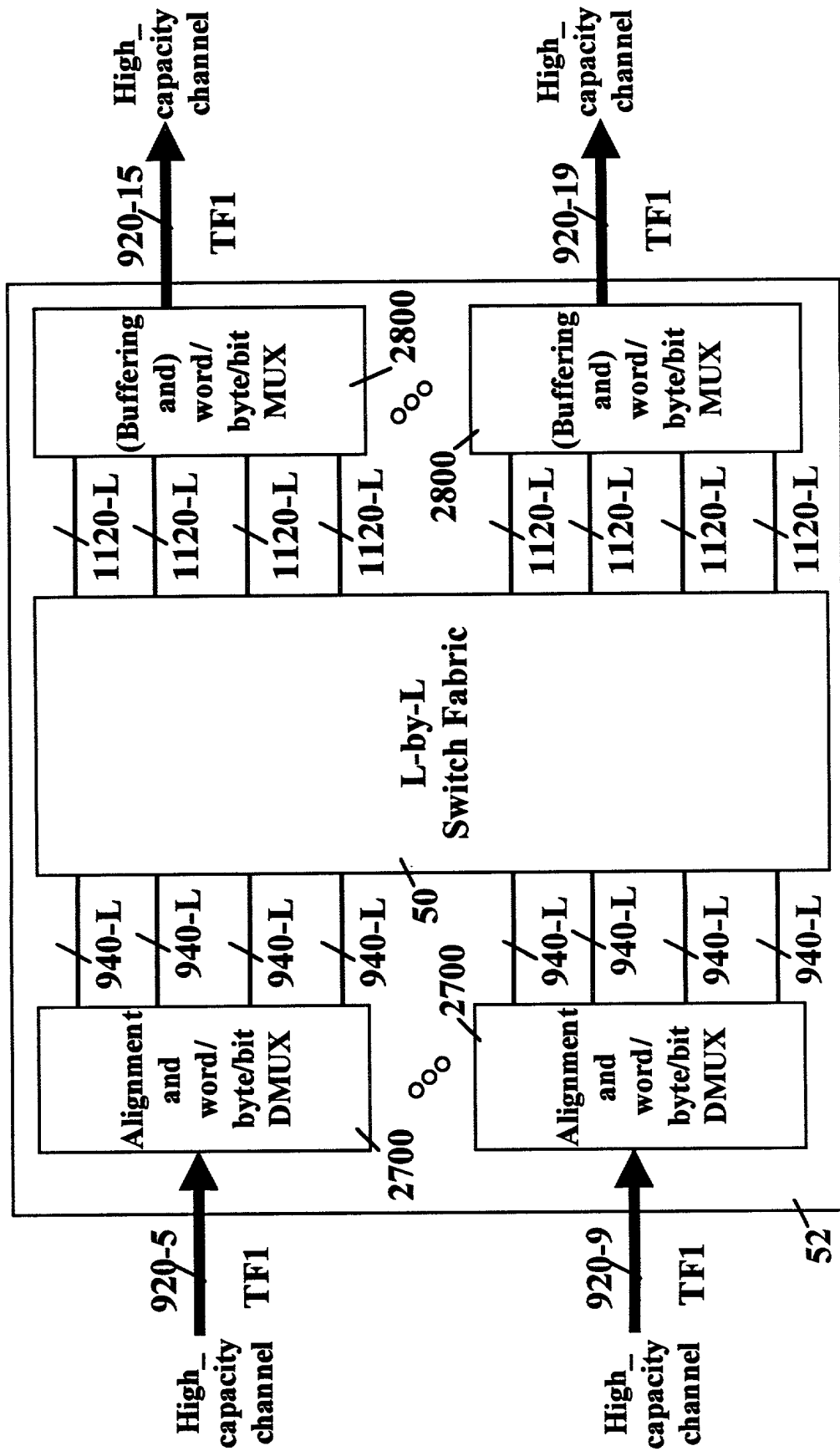
[illegible]

FIG. 28

N: number of input/output channels. E.g., N=256
 L • Low_capacity = N • High_capacity
 L = c • N > N



Time Driven Switch

FIG. 29

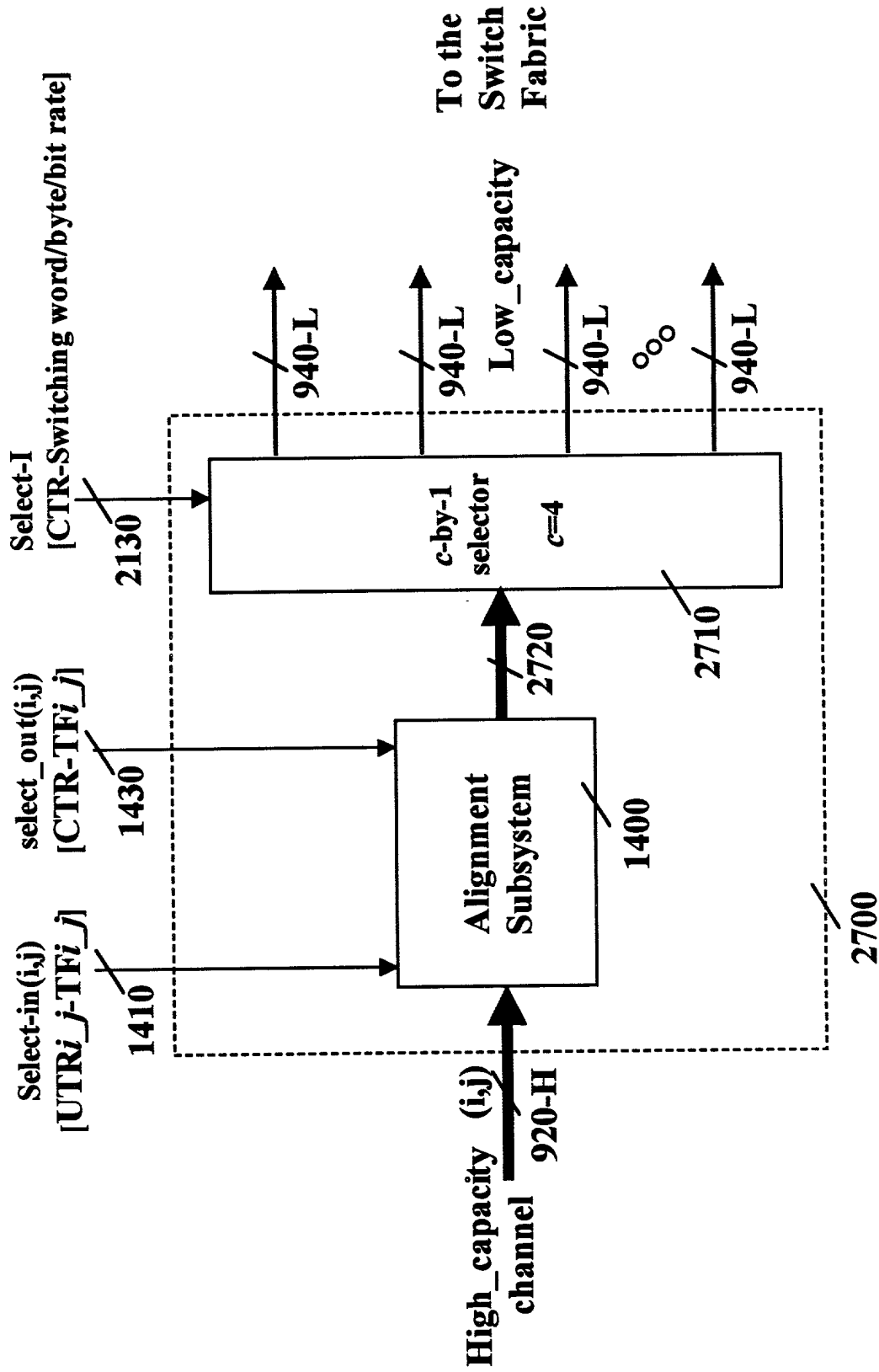


FIG. 30

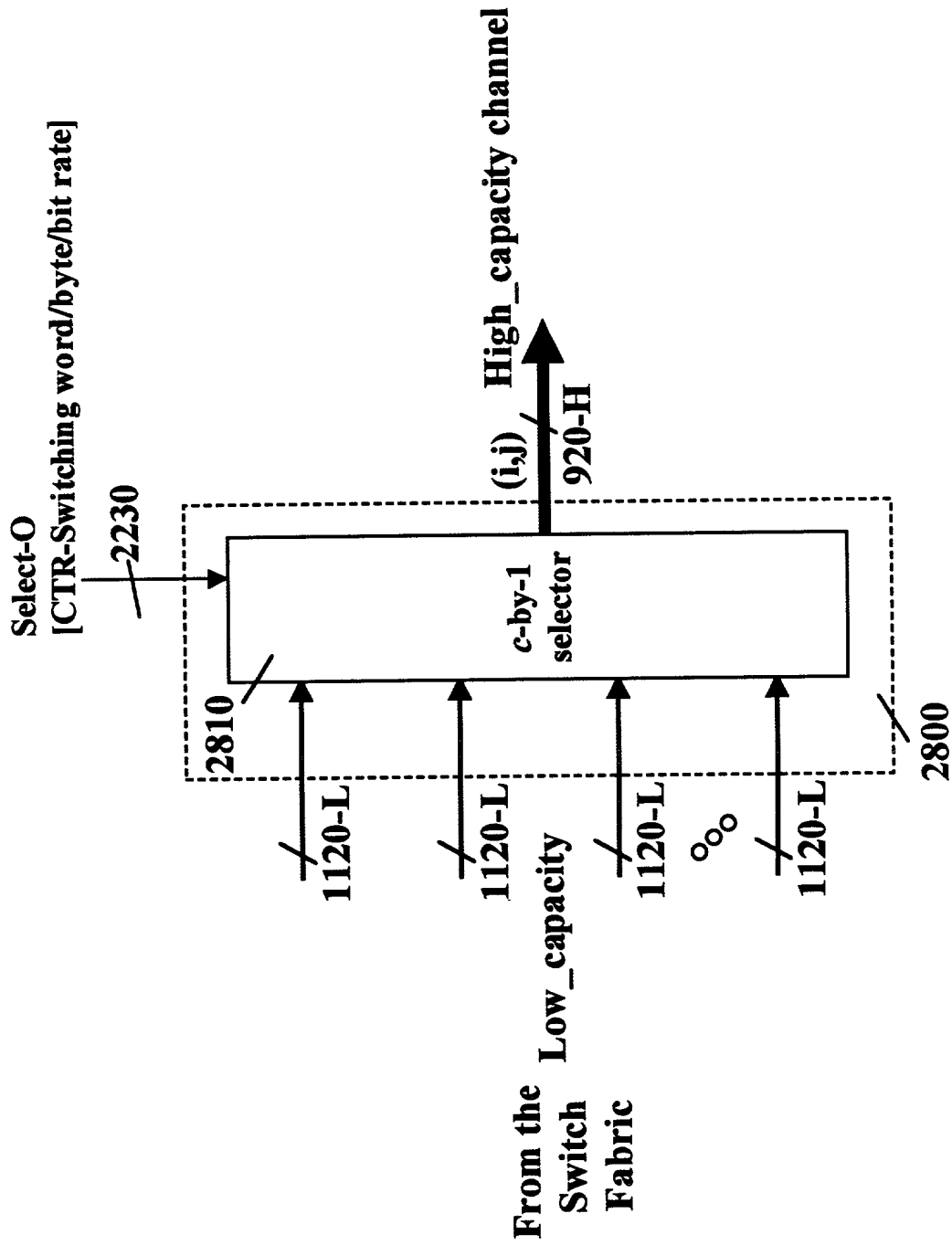


FIG. 31

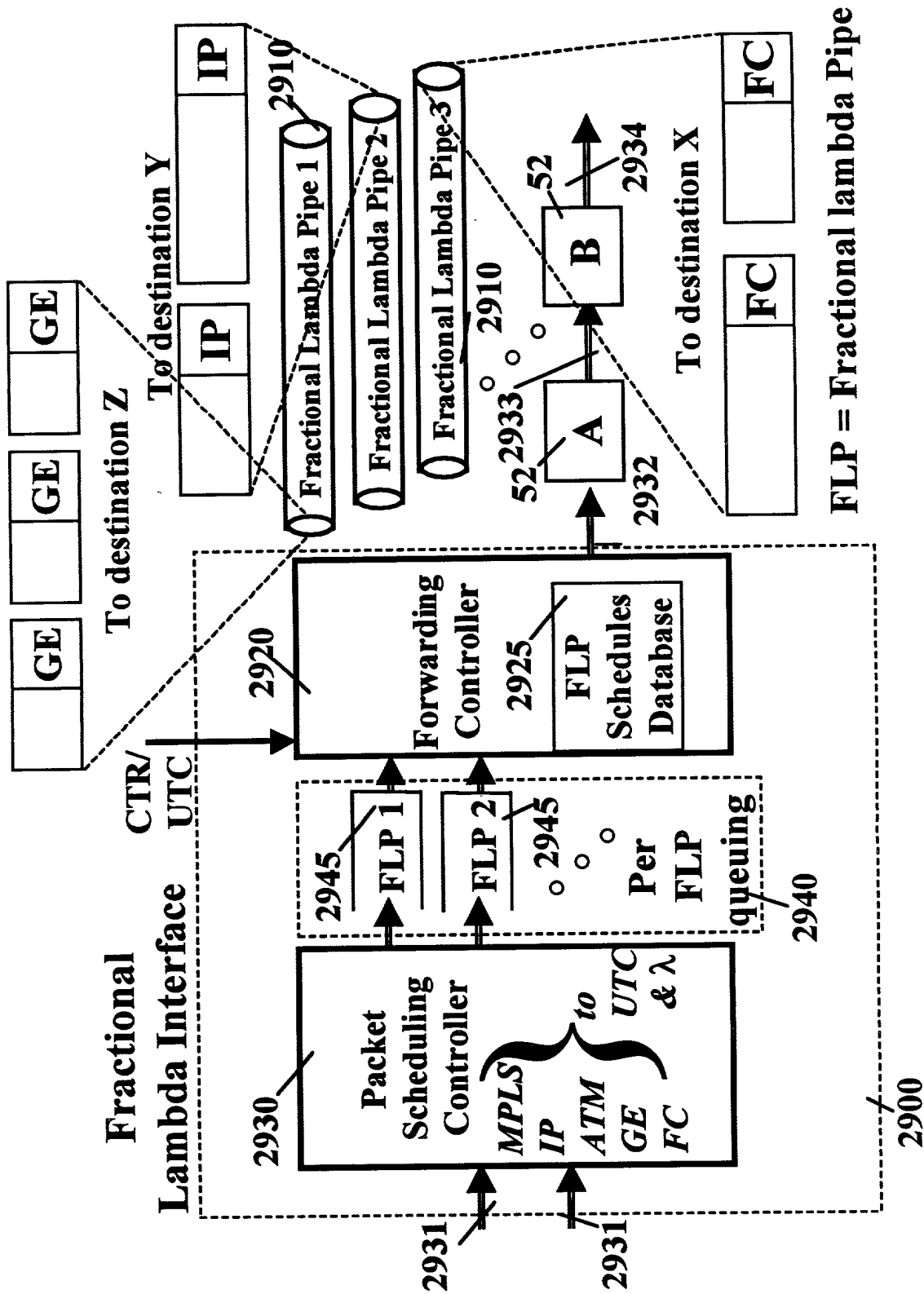


FIG. 32

Channel Capacity		TF Duration	TF Size	STS-1s	TFs/s
51.84	STS- 1	250	1620	1512	2
		500	3240	3024	4
		1000	6480	6048	8
155.52	STS- 3	125	2430	2268	3
		250	4860	4536	6
		500	9720	9072	12
622.08	STS- 12	62.5	4860	4536	6
		125	9720	9072	12
		250	19440	18144	24
2488.32	STS- 48	62.5	19440	18144	24
		31.25	9720	9072	12
		15.625	4860	4536	6
9953.28	STS- 192	7.8125	9720	9072	12
		15.625	19440	18144	24
1000	GE	125	15625	15625	19.3
		100	12500	12500	15.4
		80	10000	10000	12.3
10000	10GE	15.625	19531.25	19531.3	24.1
		12.5	15625	15625	19.3
		10	12500	12500	15.4

FIG. 33

Ch Capacity		TF Dur.	TF Size	GE TFs	TFs/s
1000	GE	80	10000	1.0	12500
51.84	STS- 1	250	1512	0.15	4000
		500	3024	0.30	2000
		1000	6048	0.60	1000
155.5	STS- 3	125	2268	0.23	8000
		250	4536	0.45	4000
		500	9072	0.91	2000
622.1	STS- 12	62.5	4536	0.45	16000
		125	9072	0.91	8000
		250	18144	1.81	4000
2488	STS- 48	62.5	18144	1.81	16000
		31.25	9072	0.91	32000
		15.625	4536	0.45	64000
9953	STS- 192	7.8125	9072	0.91	128000
		15.625	18144	1.81	64000
10000	10GE	8	10000	1.00	125000
		16	20000	2.00	62500

FIG. 33

FIG. 34

Ch Capacity		TF Dur.	TF Size	GE TFs	TFs/s
1000	GE	62.5	7812.5	1.0	16000
51.84	STS- 1	250	1512	0.19	4000
		500	3024	0.39	2000
		1000	6048	0.77	1000
155.52	STS- 3	125	2268	0.29	8000
		250	4536	0.58	4000
		500	9072	1.16	2000
622.08	STS- 12	62.5	4536	0.58	16000
		125	9072	1.16	8000
		250	18144	2.32	4000
2488.32	STS- 48	62.5	18144	2.32	16000
		31.25	9072	1.16	32000
		15.625	4536	0.58	64000
9953.28	STS- 192	7.8125	9072	1.16	128000
		15.625	18144	2.32	64000
10000	10GE	12.5	15625	2.00	80000
		25	31250	4.00	40000

FIG. 35

TF Alignment of UTR(i) to UTC - with three input queues - principle of operation:
 The same queue is not used simultaneously for:
 1. Receiving data packets from the serial link, and
 2. Forwarding data packets to the switch

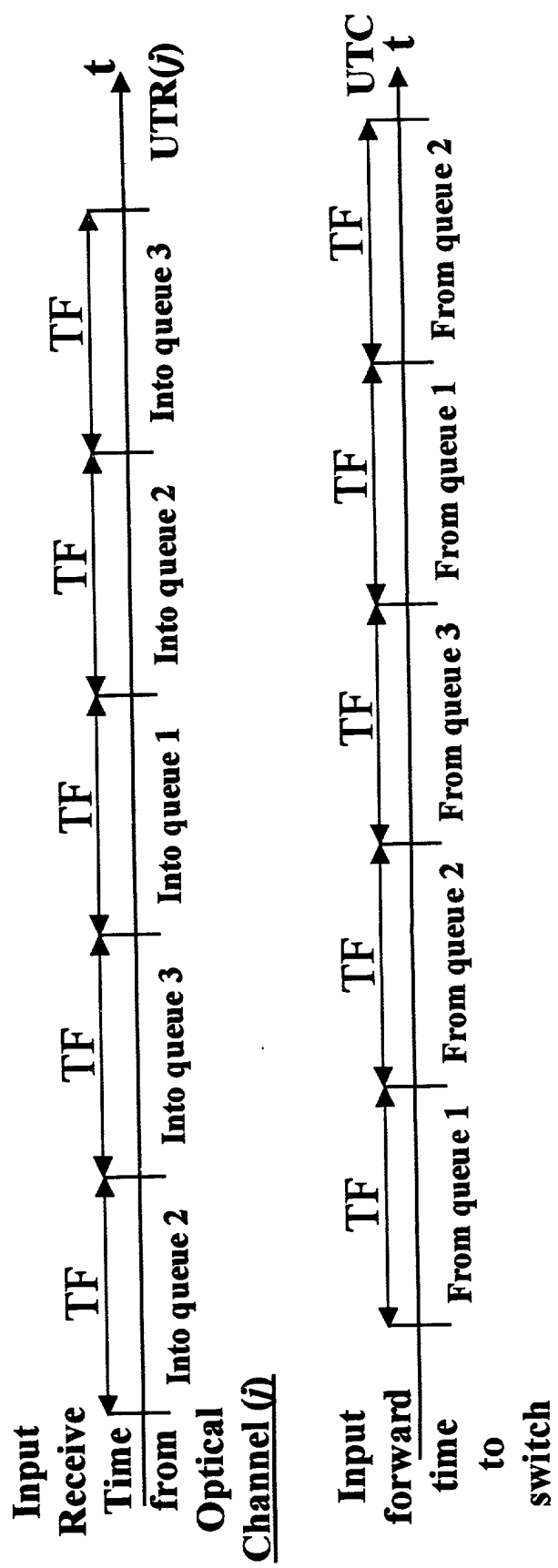


FIG. 36

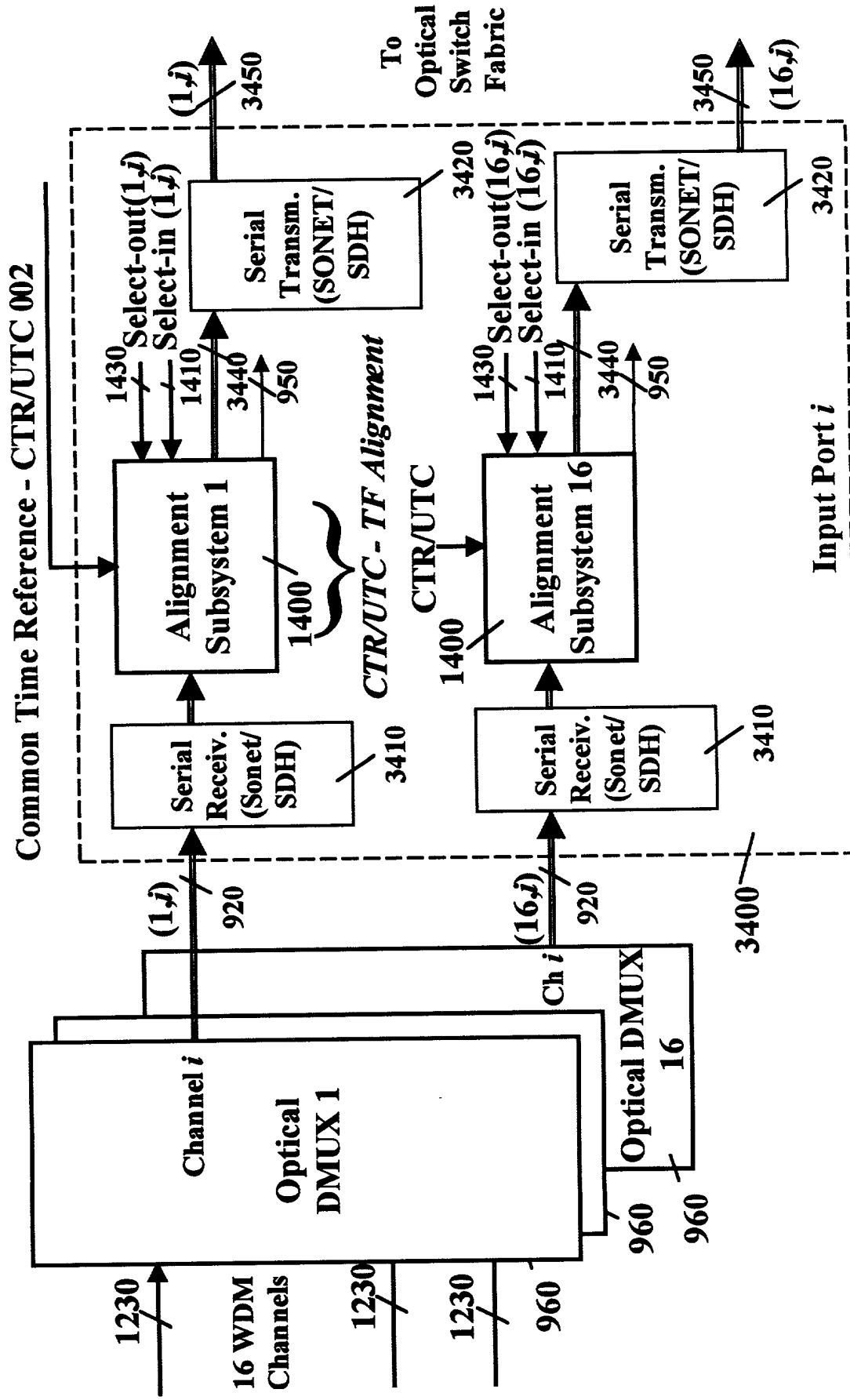


FIG. 37

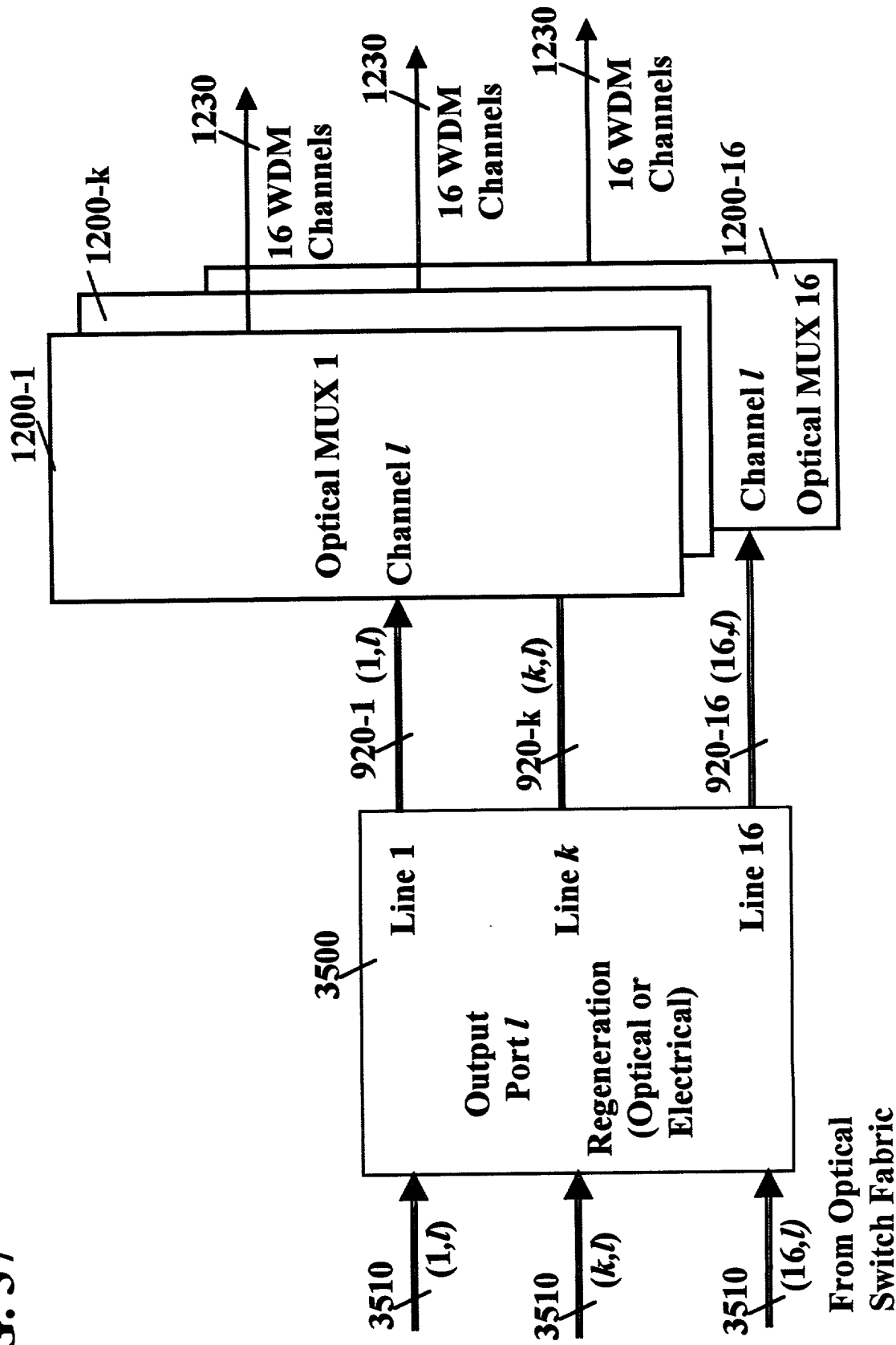


FIG. 38

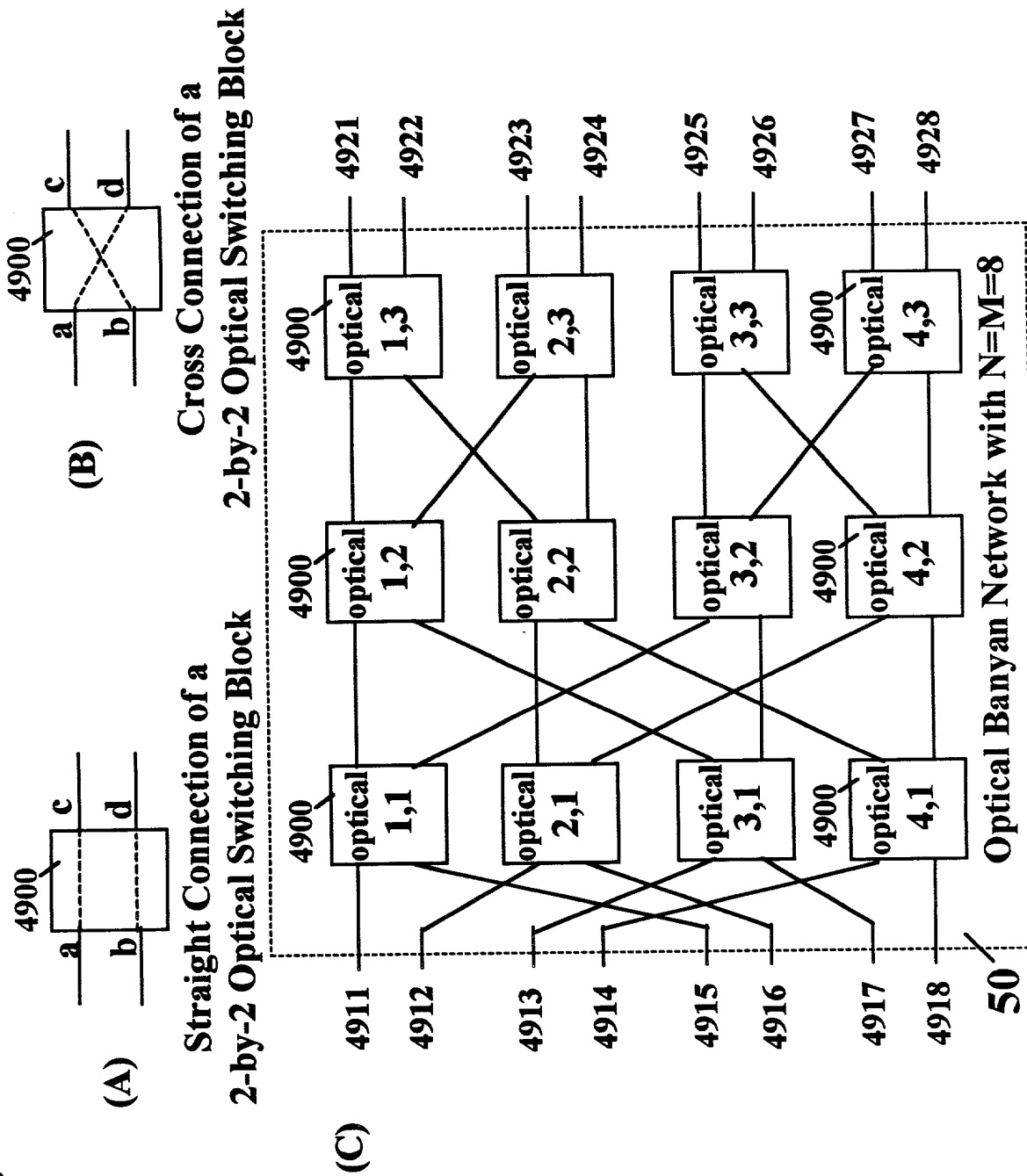
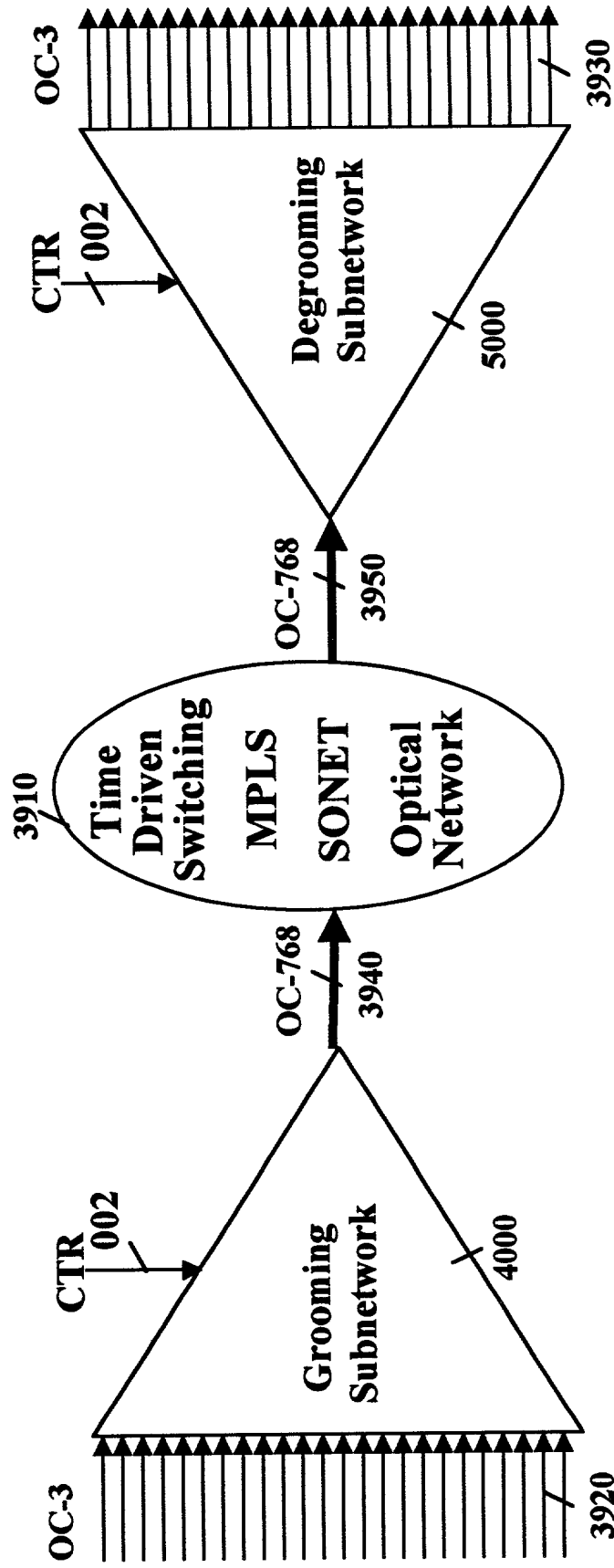


FIG. 39



[illegible]

FIG. 41

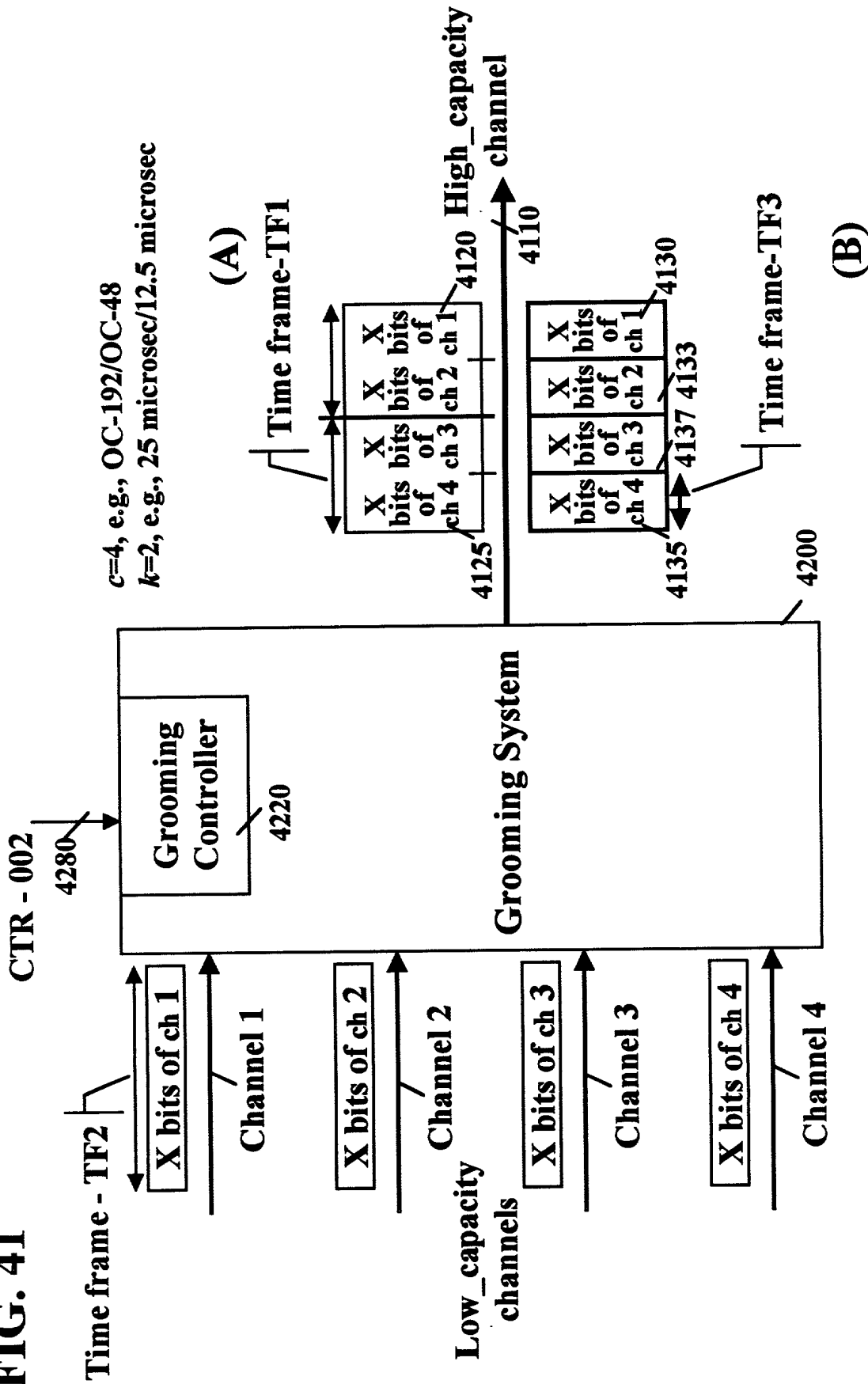


FIG. 42

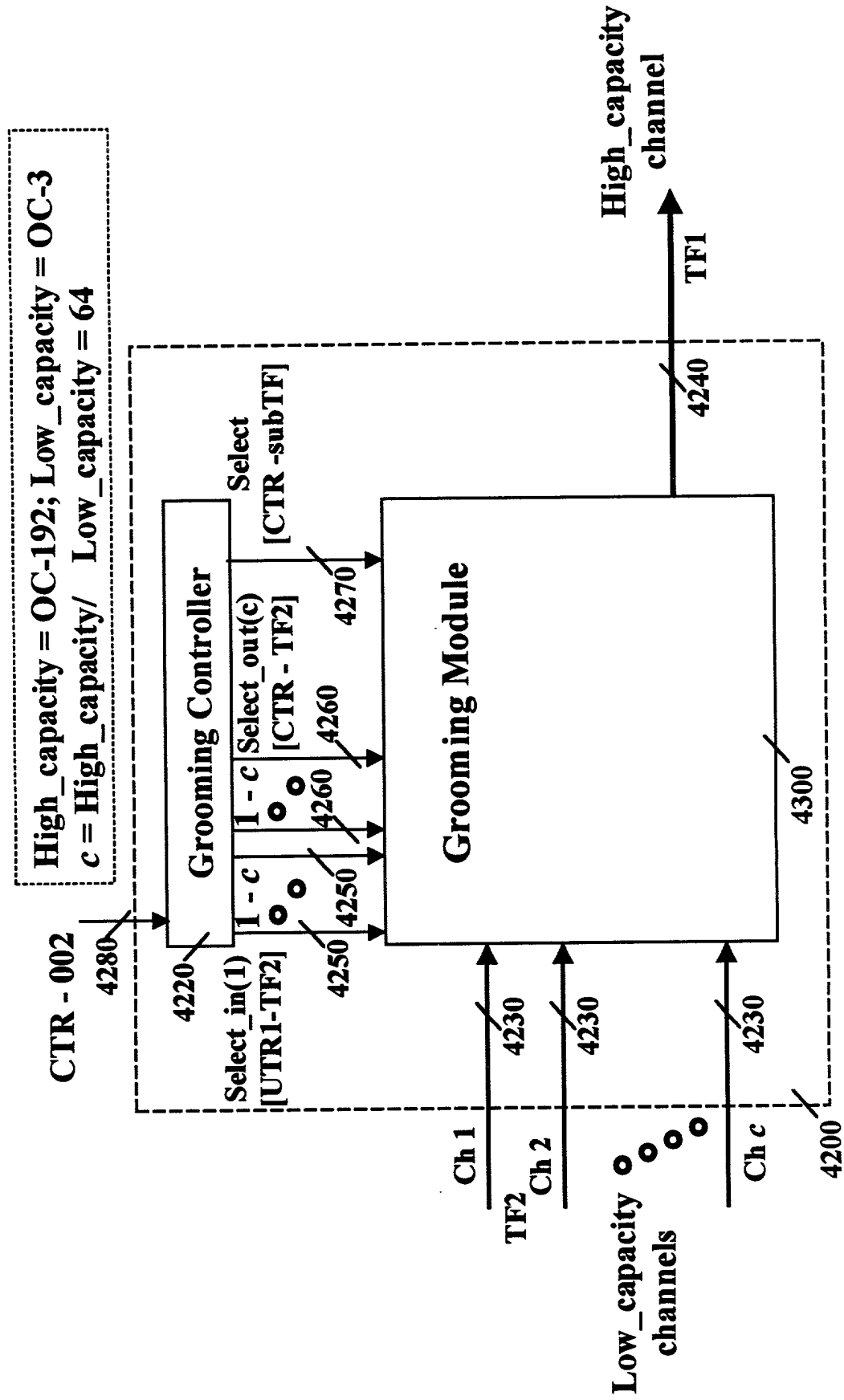


FIG. 43

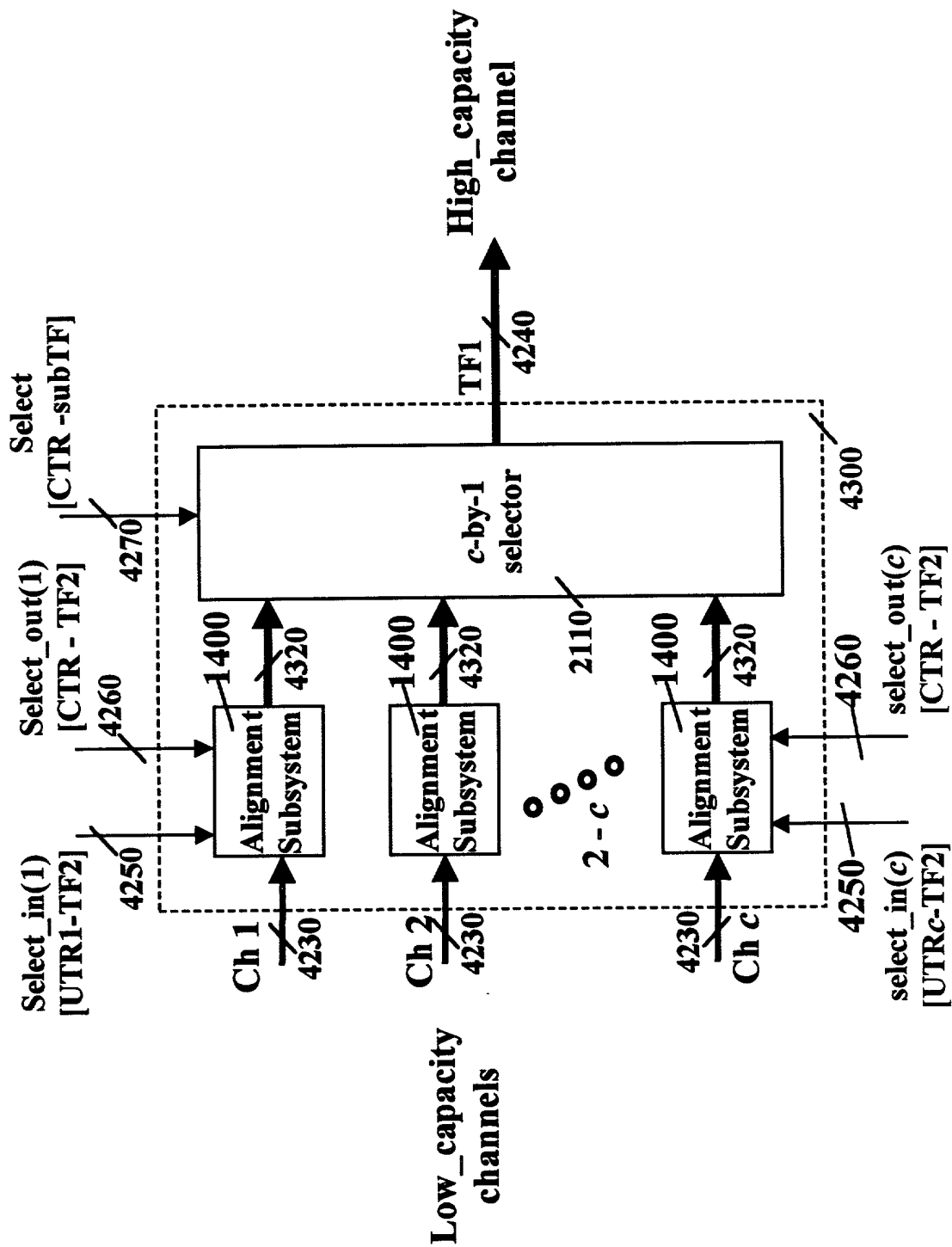


FIG. 44 • $CC1_length \cdot TF1 = CC2_length \cdot TF2 = CC3_length \cdot TF2$

- $TF2 = (SC1_length / SC2_length) \cdot TF1 = k \cdot TF1$, where the common cycles of $TF1$ and $TF2$ are aligned with respect to UTC.

For $k = 2$ and $c = 4$ (e.g., High_capacity=OC-192, Low_capacity=OC-48):

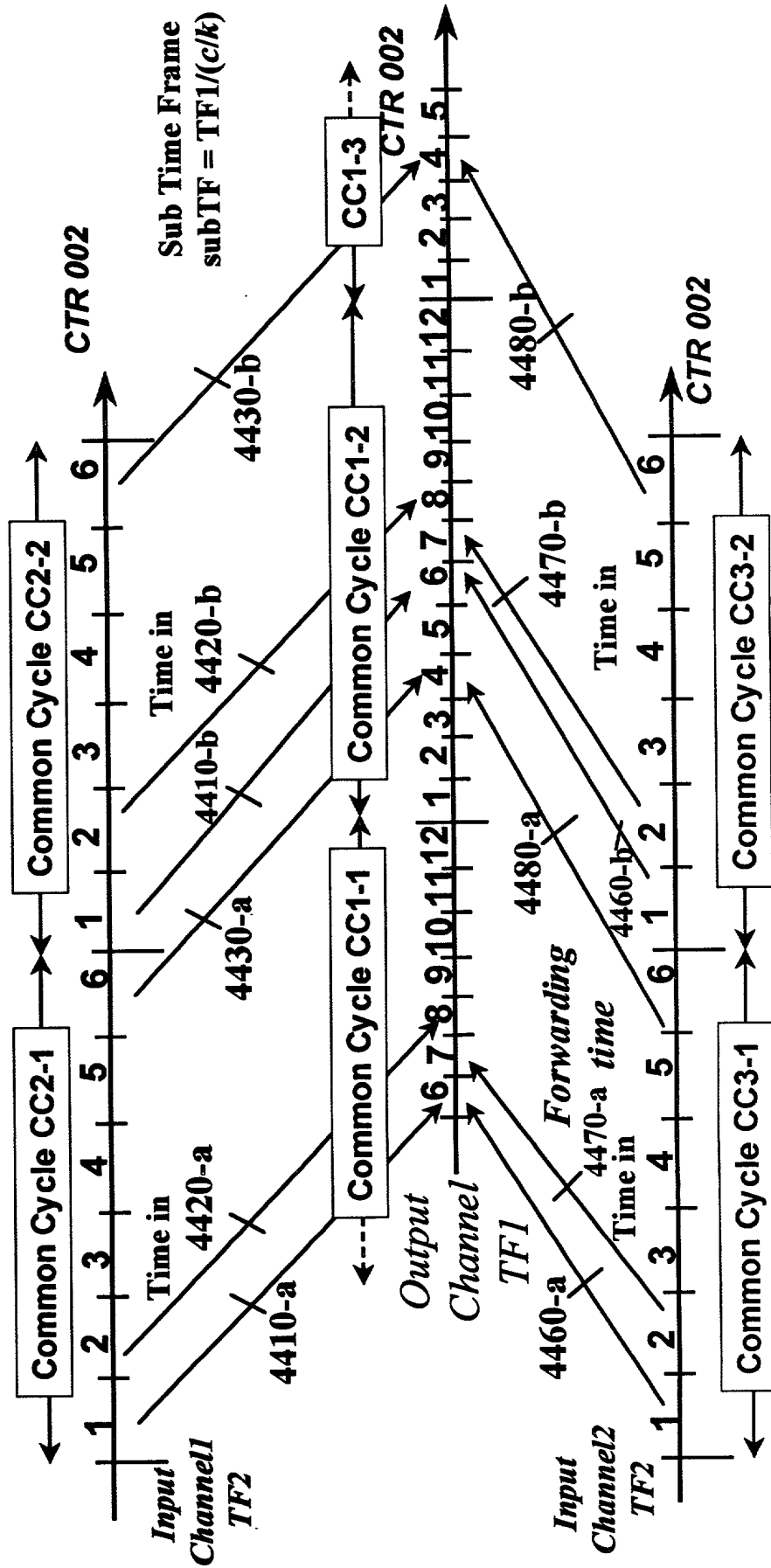


FIG. 45

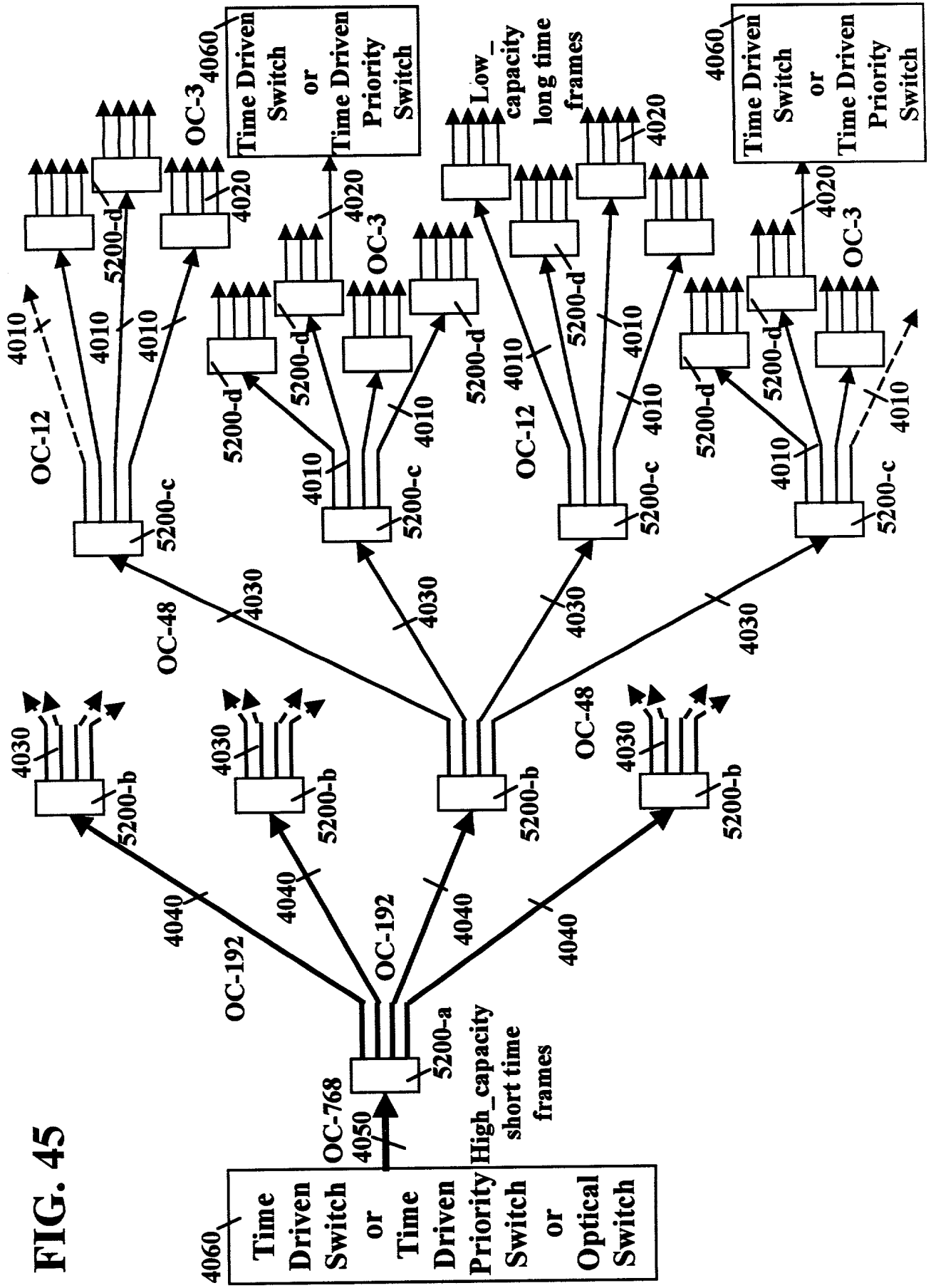
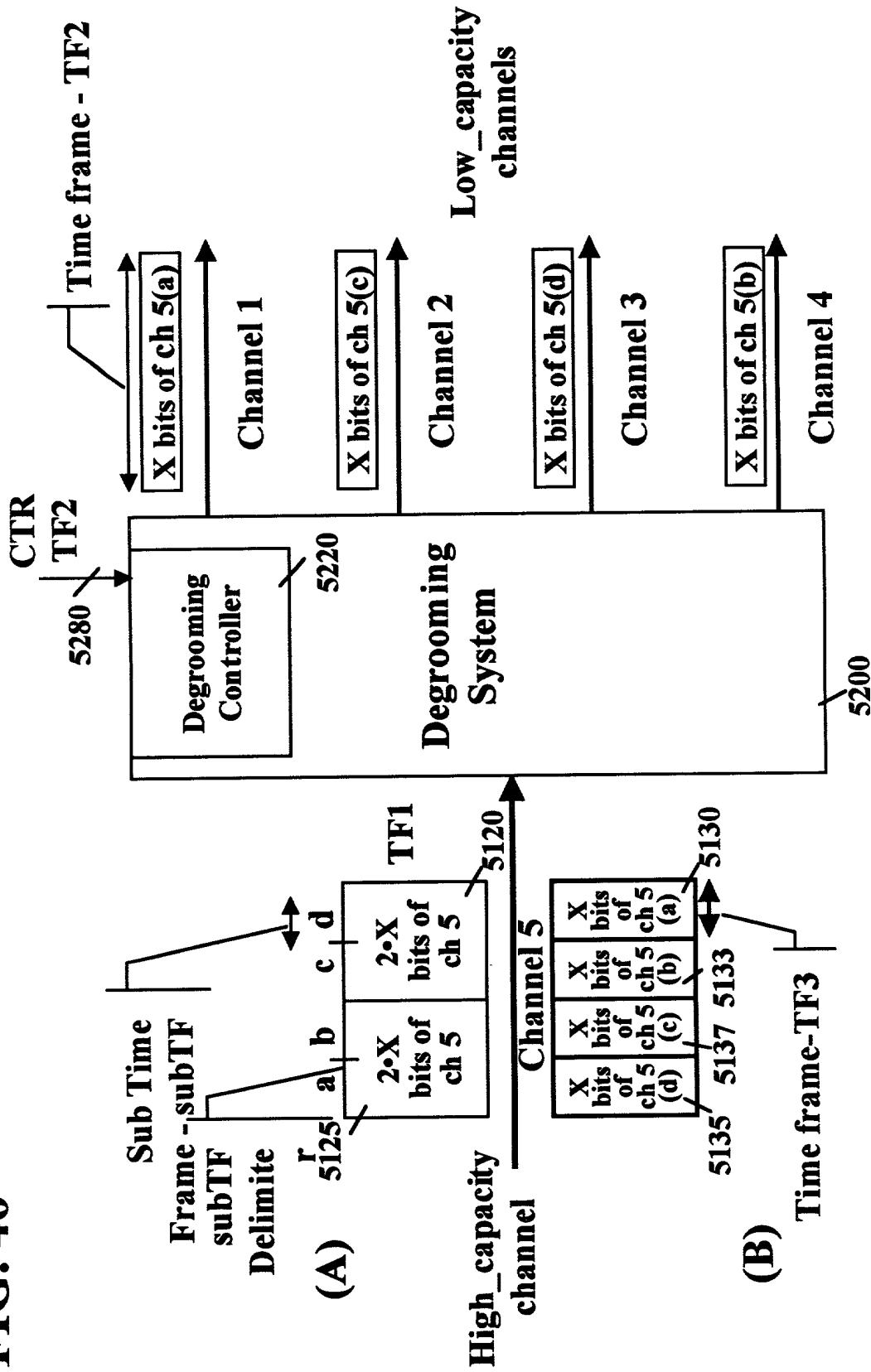


FIG. 46



c=4, e.g., OC-192/OC-48
k=2, e.g., 25 microsec/12.5 microsec

FIG. 47

High_capacity = OC-192
 Low_capacity = OC-3
 $c = \text{High_capacity} / \text{Low_capacity} = 64$

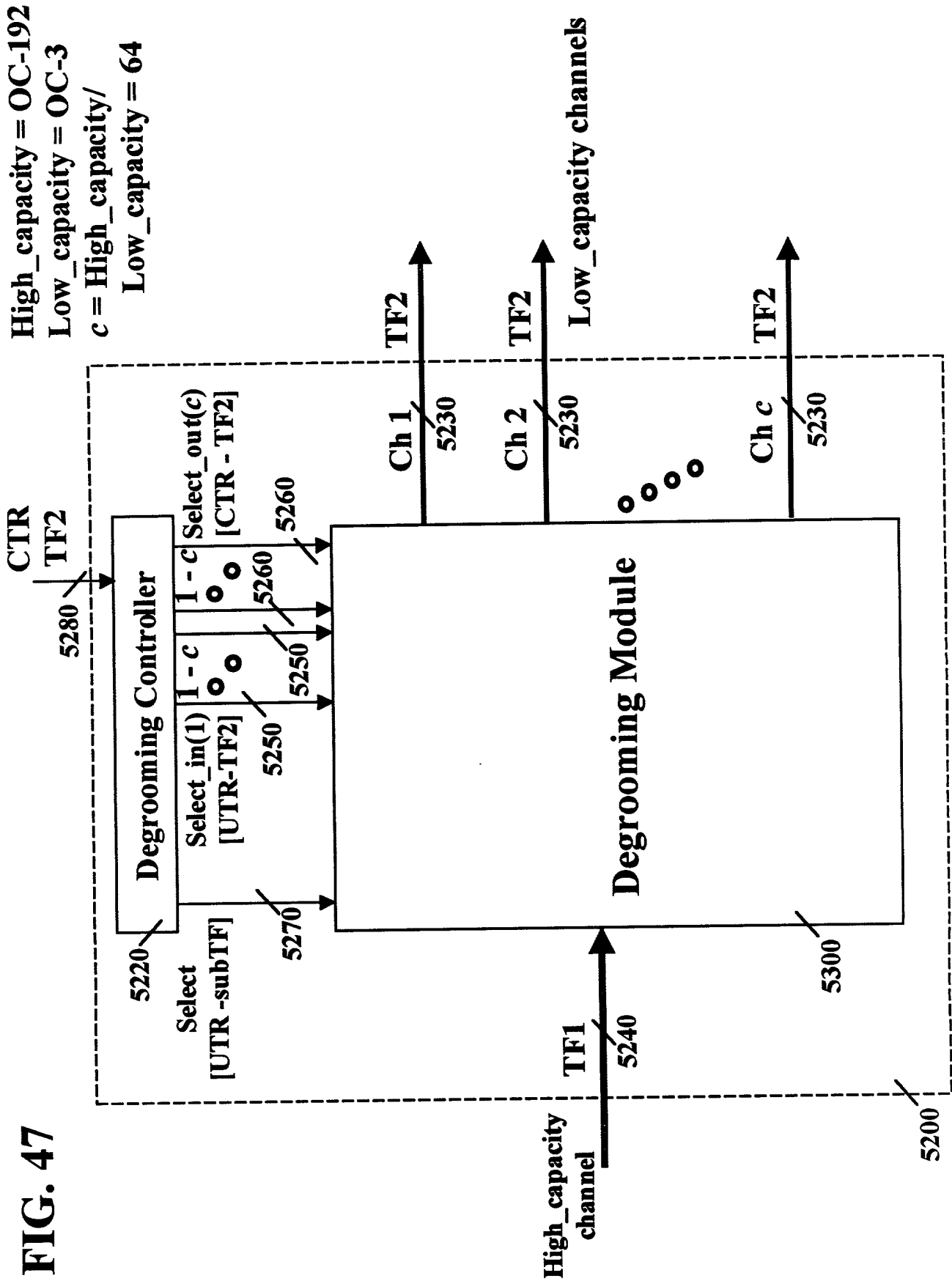


FIG. 48

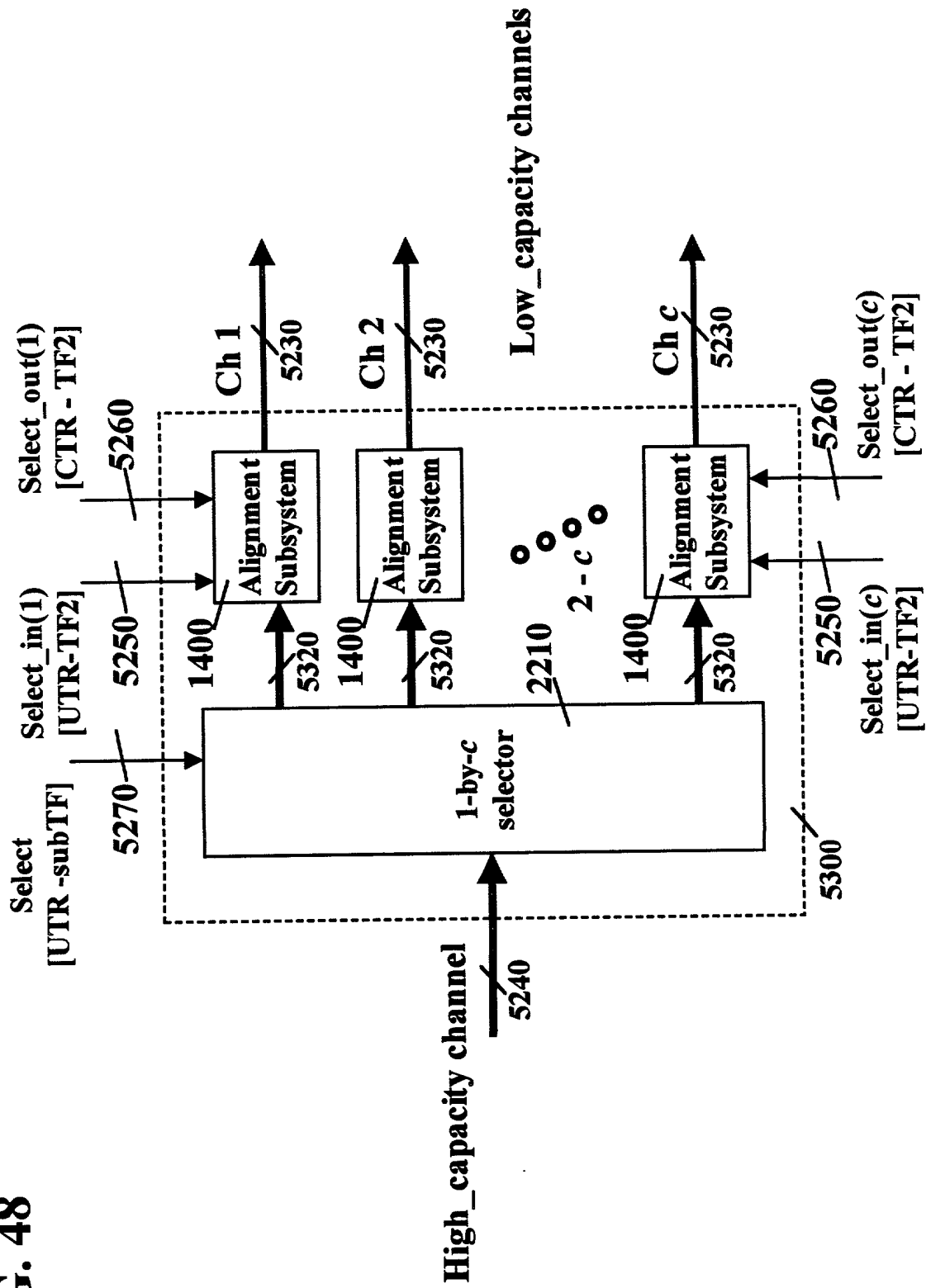
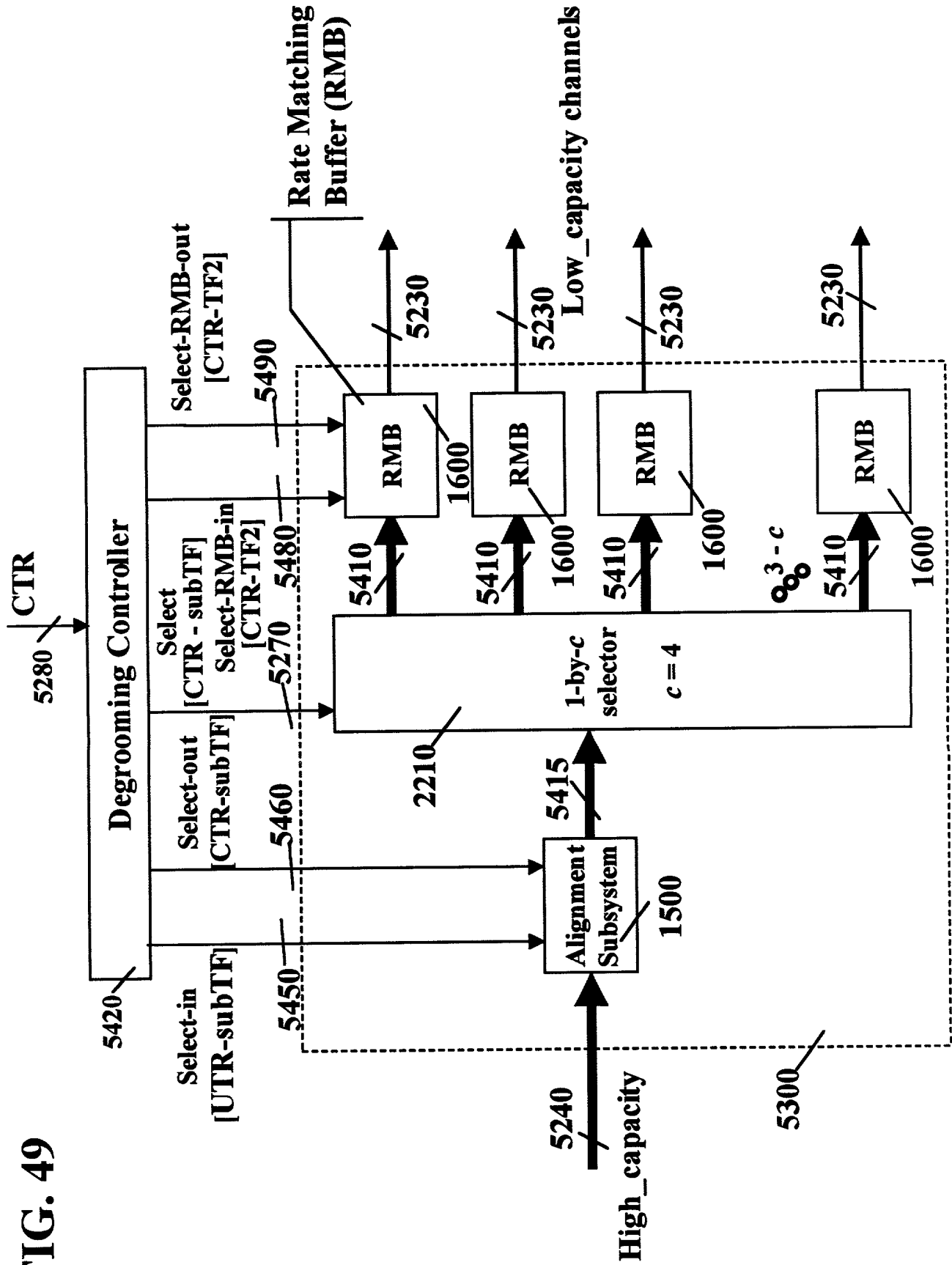
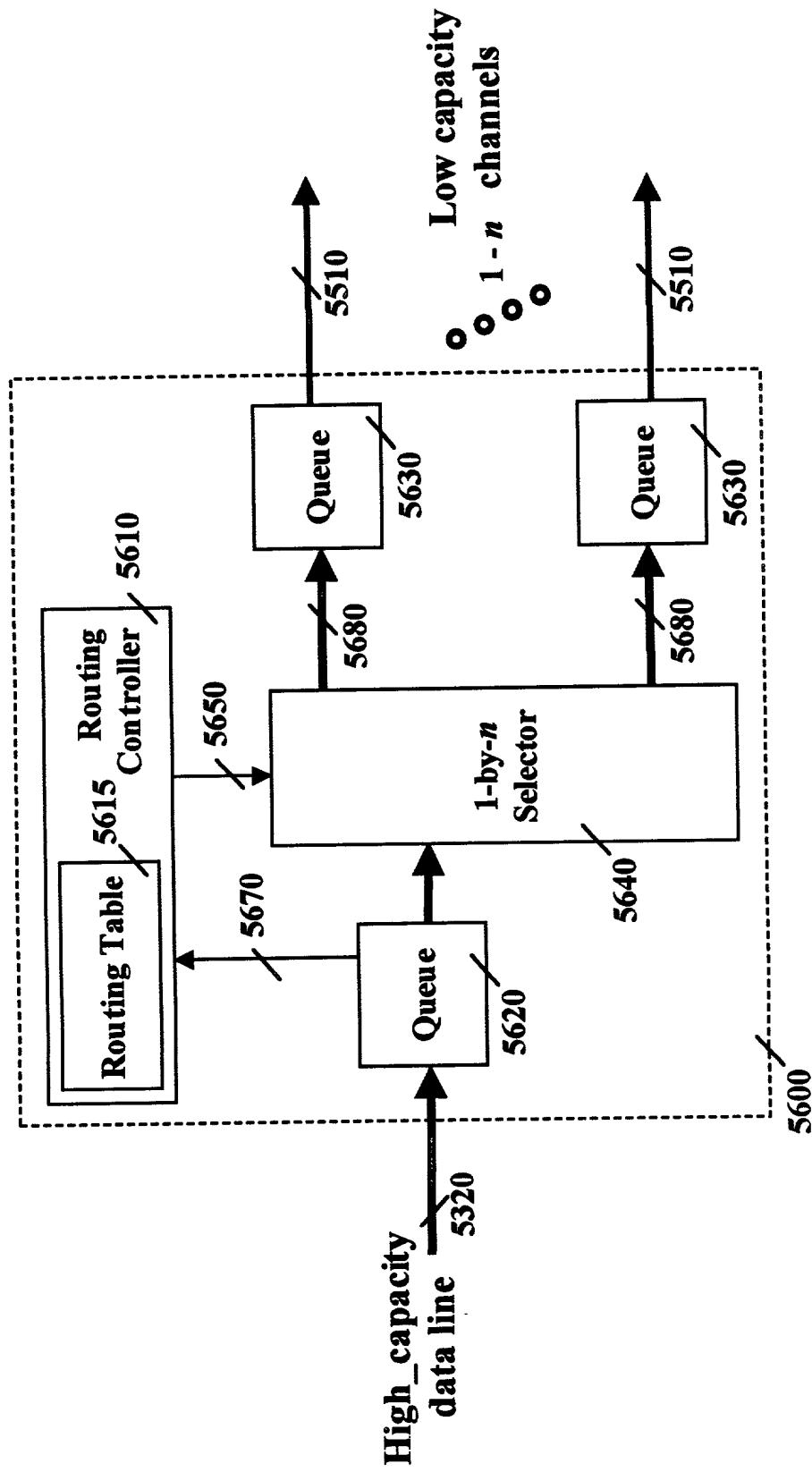


FIG. 49



[illegible]

FIG. 51



- $CC1_length \cdot TF1 = CC2_length \cdot TF2 = CC3_length \cdot TF2$
 - $TF2 = (SC1_length / SC2_length) \cdot TF1 = k \cdot TF1$, where the common cycles of $TF1$ and $TF2$ are aligned with respect to UTC.
- For $k = 2$ and $c = 4$ (e.g., High_capacity=OC-192, Low_capacity=OC-48):

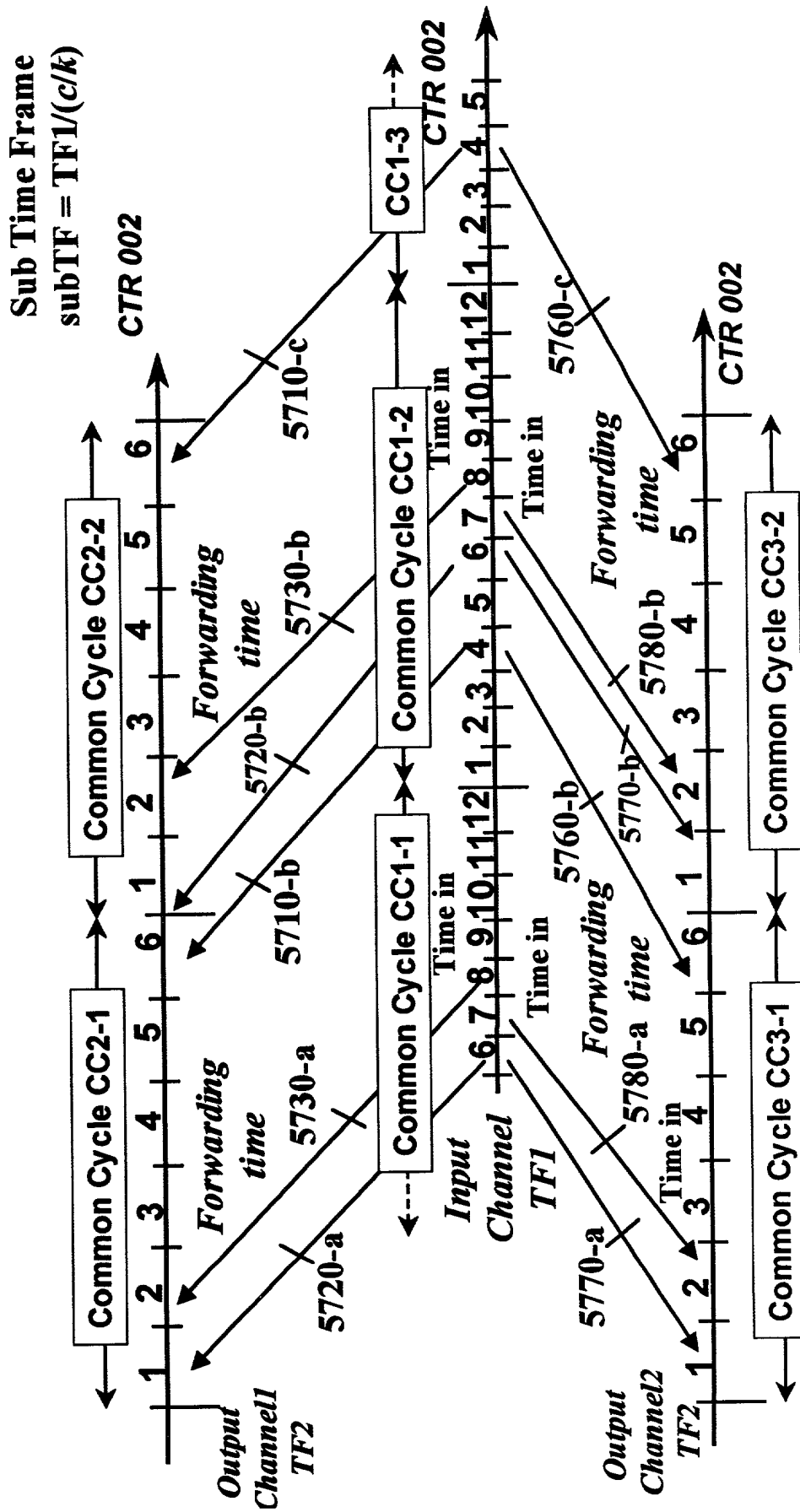
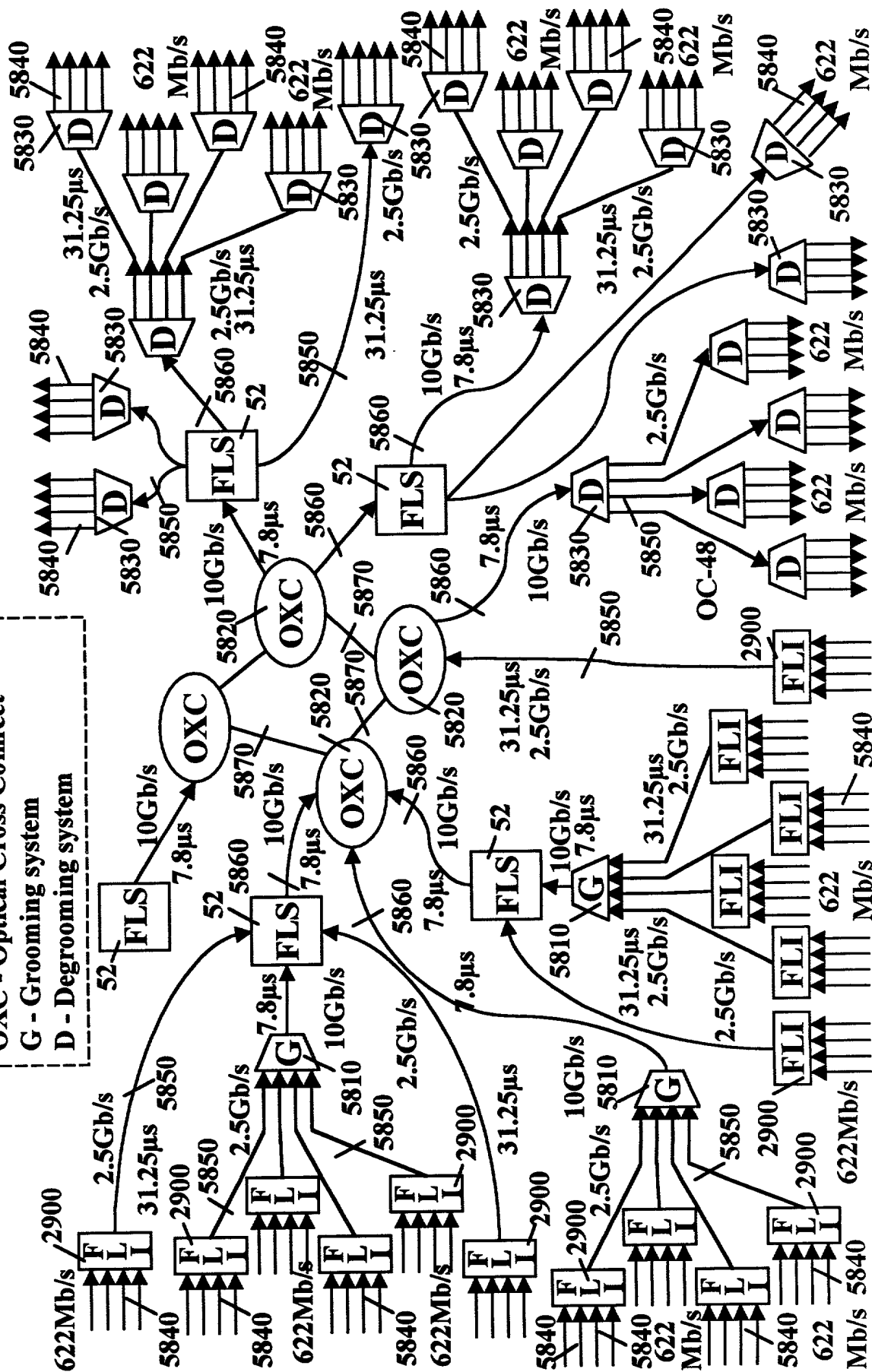


FIG. 53

FLI - Fractional Lambda Interface
 FLS - Fractional Lambda Switch
 OXC - Optical Cross Connect
 G - Grooming system
 D - Degrooming system

Time Frame size 9720 KB



12 STS-1s per time frame

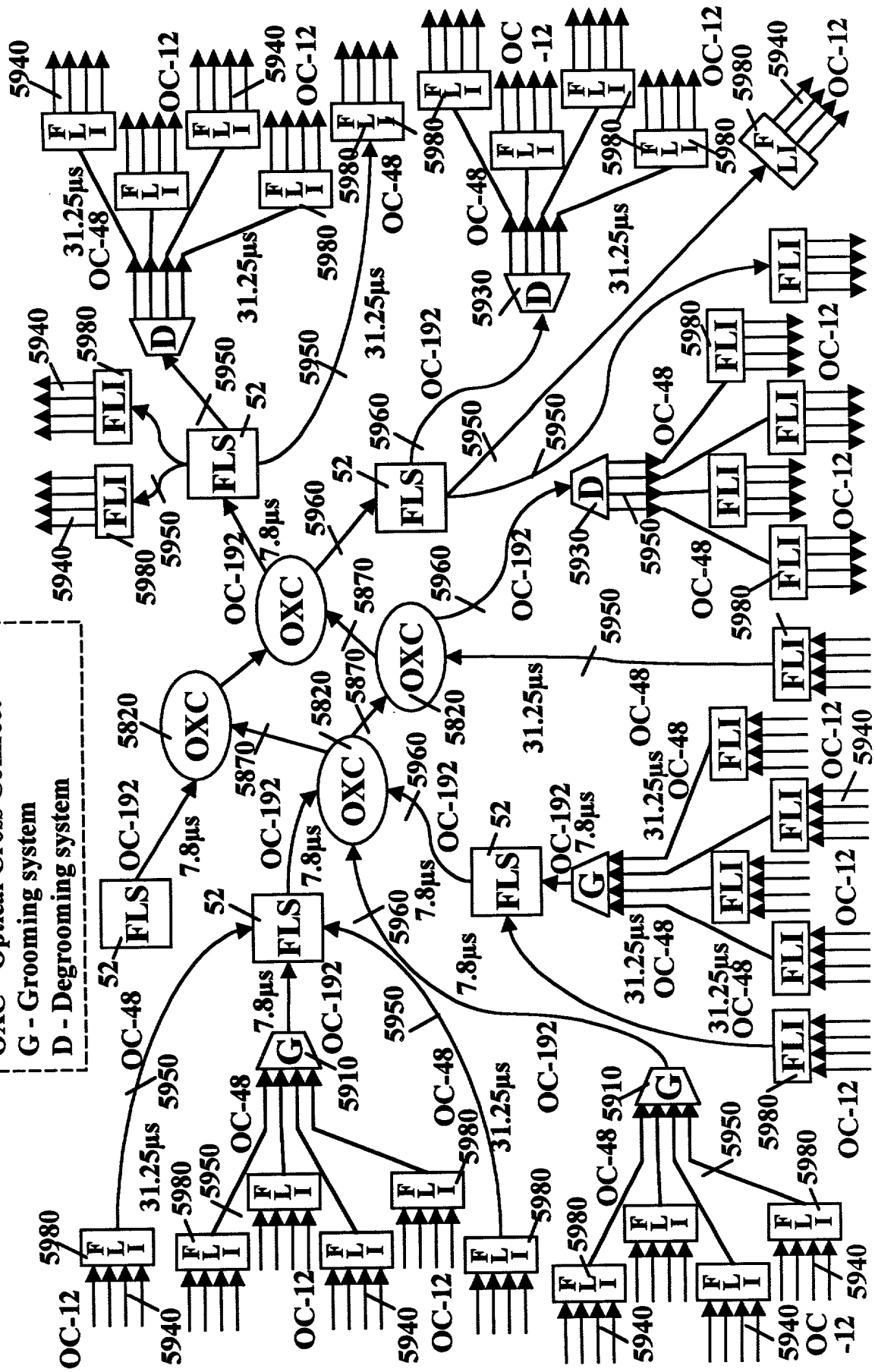


FIG. 55

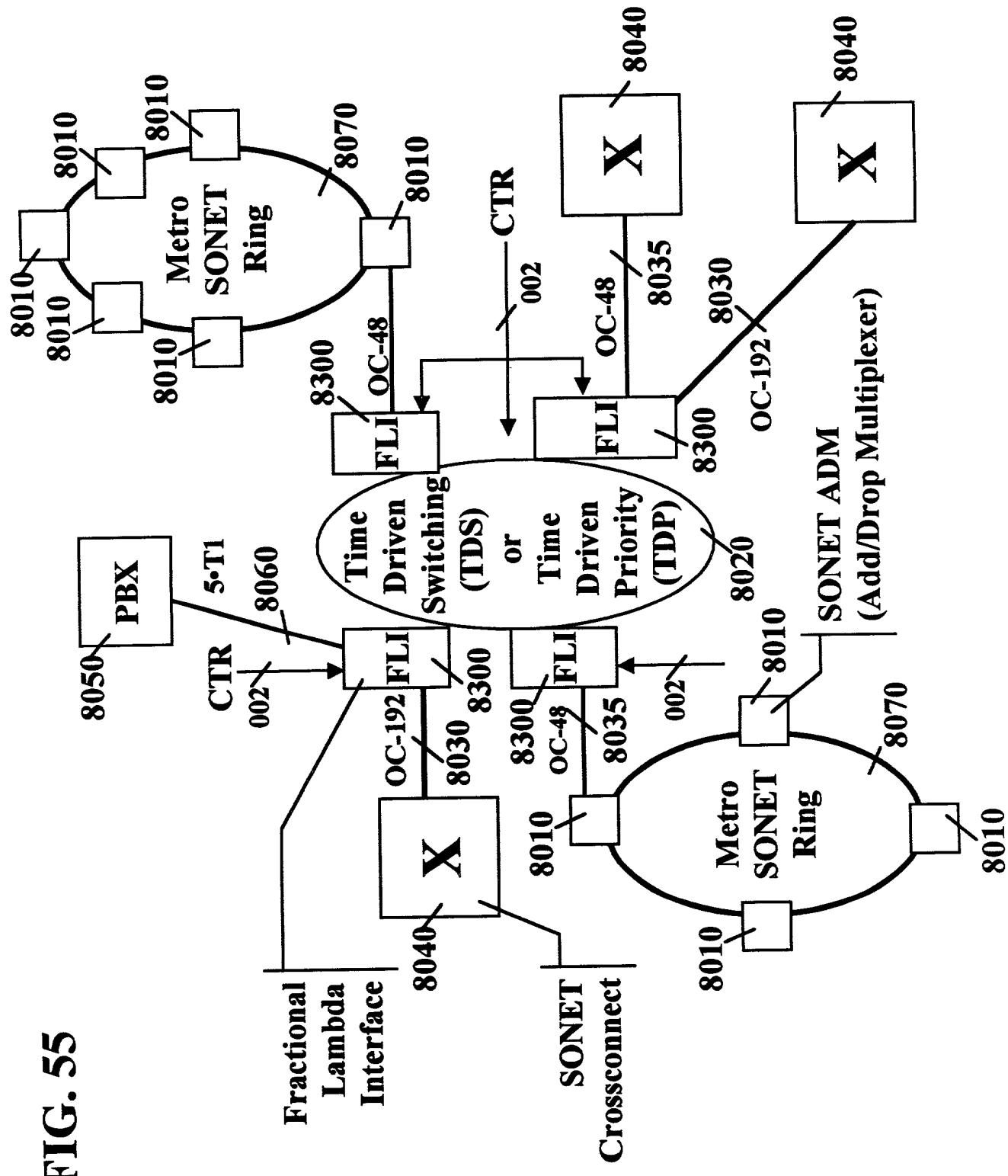


FIG. 56

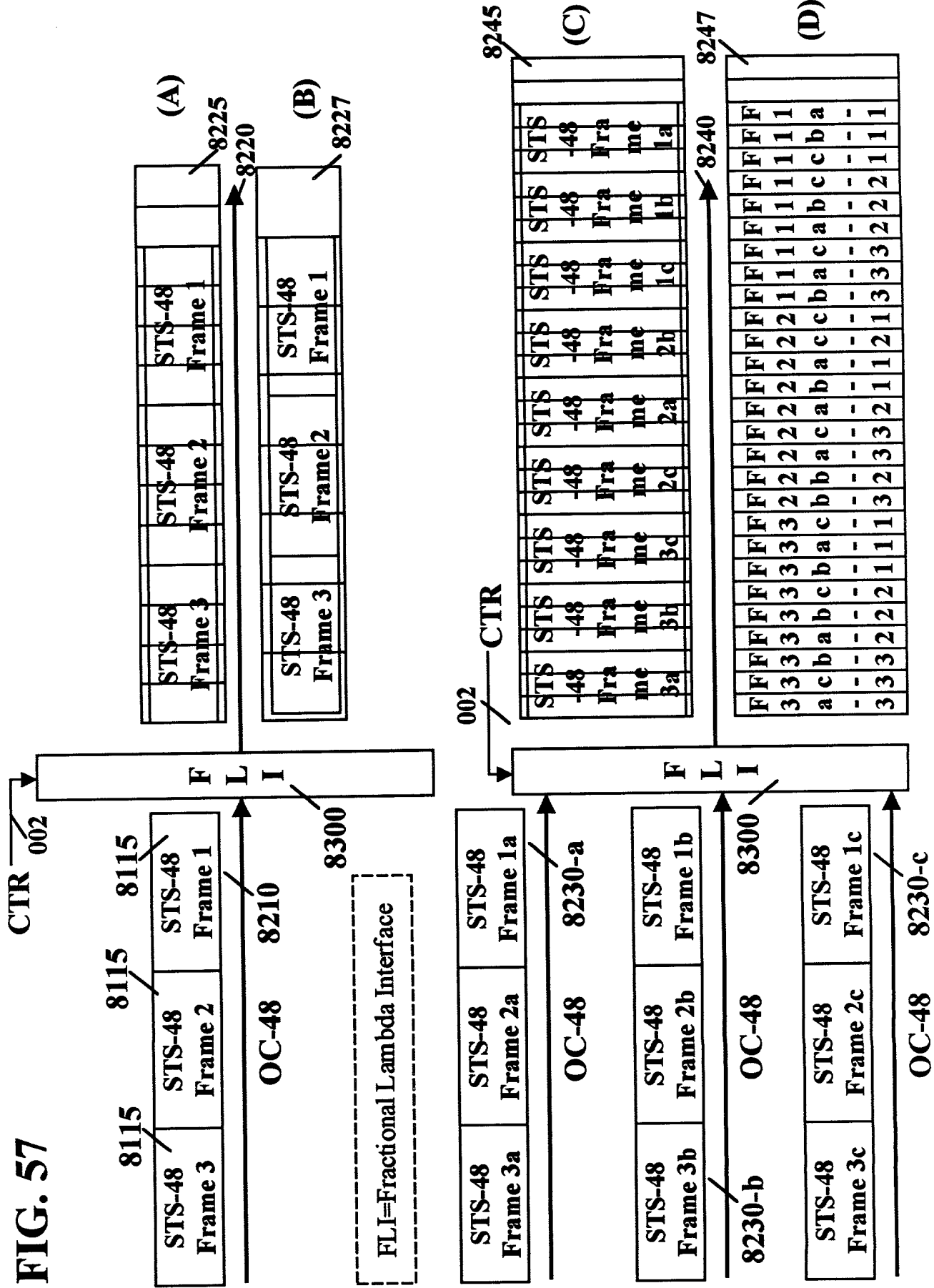
The diagram illustrates a Fractional Lambda Interface (FLI) system. It consists of three parallel processing paths, each receiving a common control signal **CTR 002** and feeding into a common **FLI** block.

- Path 8110:** This path processes three STS-48 frames: **Frame 3**, **Frame 2**, and **Frame 1**. These frames are grouped under the label **OC-48 8110**. The output of this path is labeled **8300**.
- Path 8130-a:** This path processes three STS-48 frames: **Frame 3a**, **Frame 2a**, and **Frame 1a**. These frames are grouped under the label **OC-48 8130-a**. The output of this path is labeled **8300**.
- Path 8130-b:** This path processes three STS-48 frames: **Frame 3b**, **Frame 2b**, and **Frame 1b**. These frames are grouped under the label **OC-48 8130-b**. The output of this path is labeled **8300**.
- Path 8130-c:** This path processes three STS-48 frames: **Frame 3c**, **Frame 2c**, and **Frame 1c**. These frames are grouped under the label **OC-48 8130-c**. The output of this path is labeled **8300**.

A dashed box labeled **FLI=Fractional Lambda Interface** is positioned between the first and second paths. The common output of all paths is labeled **8300**.

[illegible]

FIG. 57



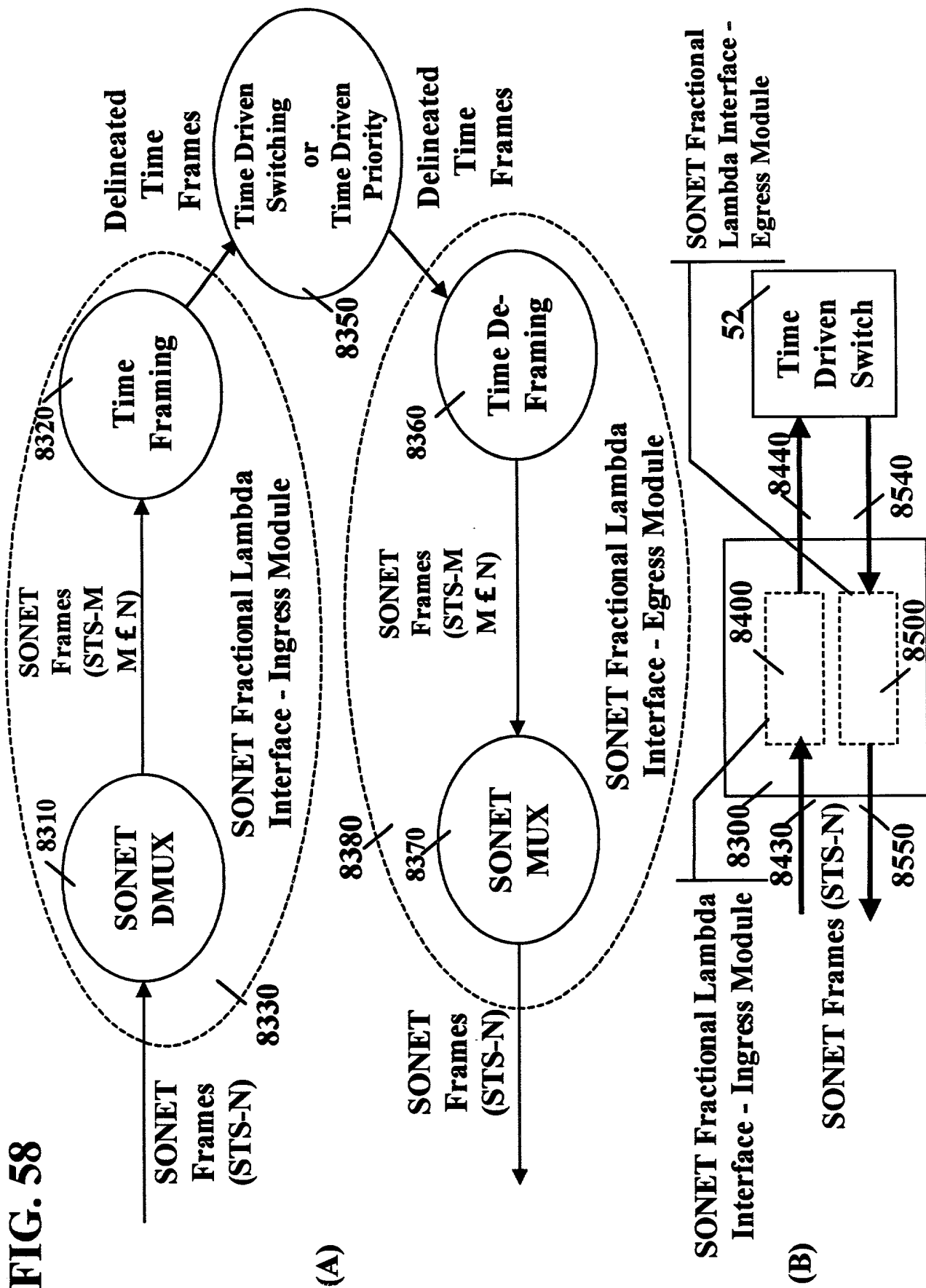


FIG. 59

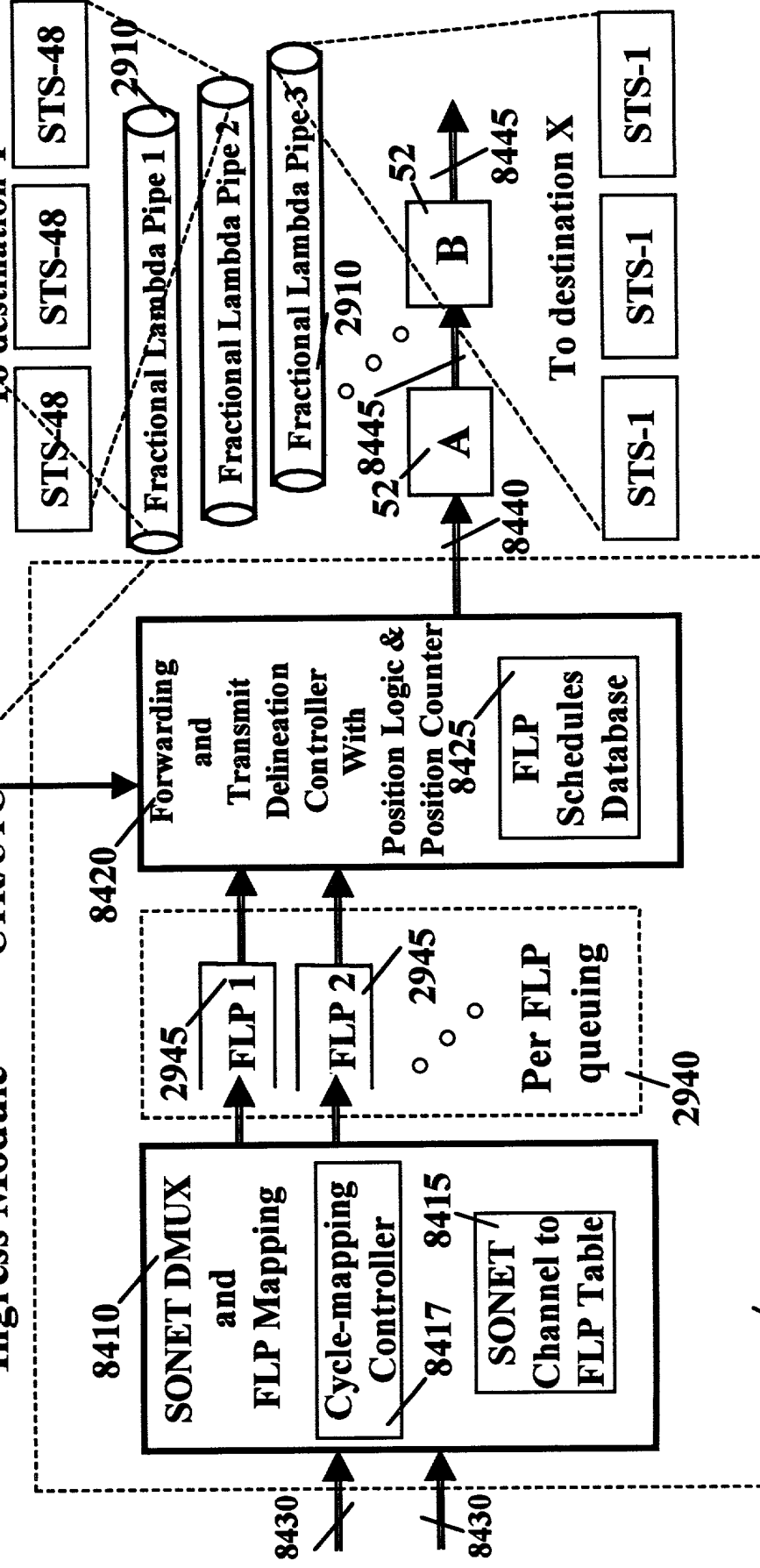
SONET Fractional
Lambda Interface -
Ingress Module

CTR/UTC

To destination Z

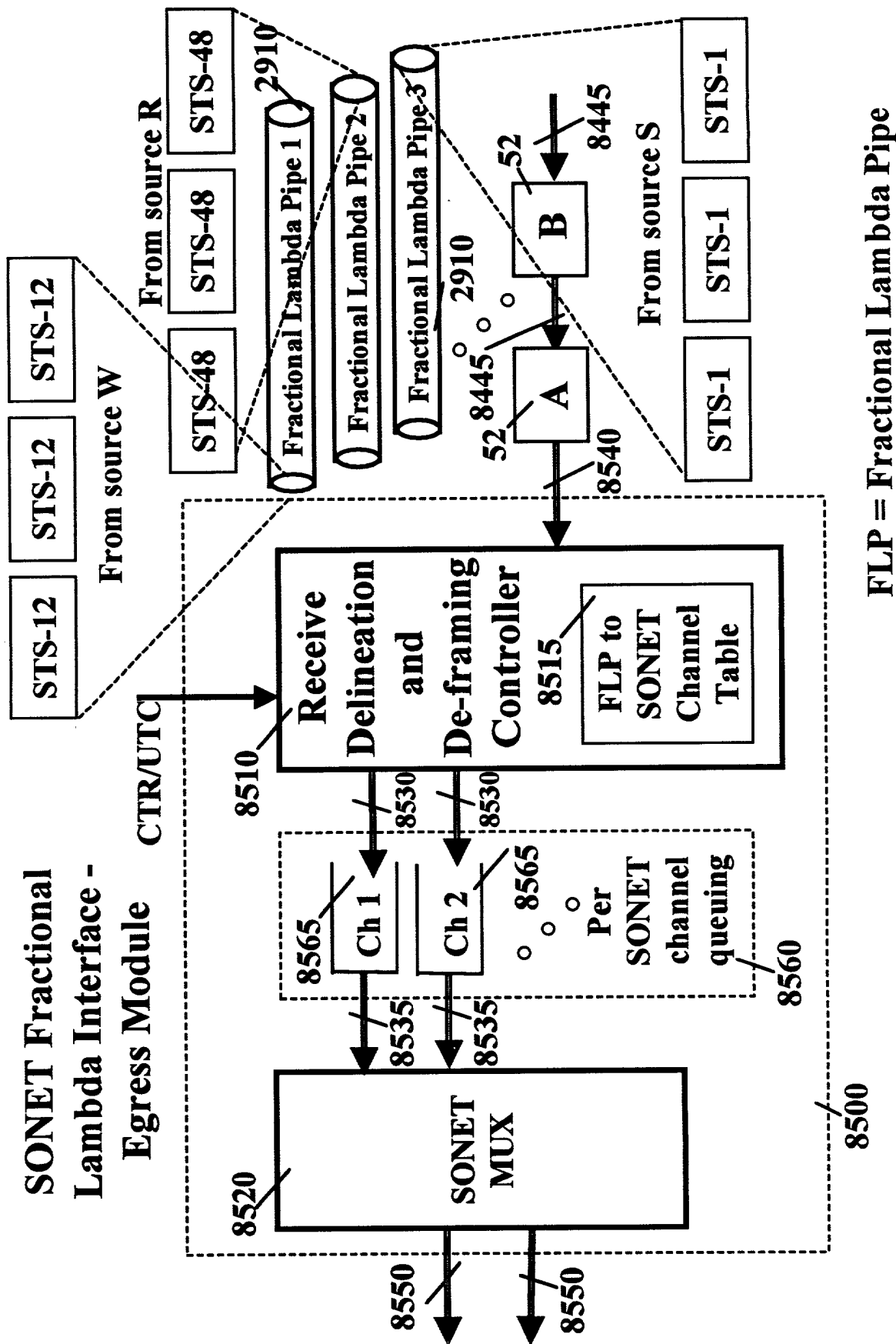
To destination Y

To destination X

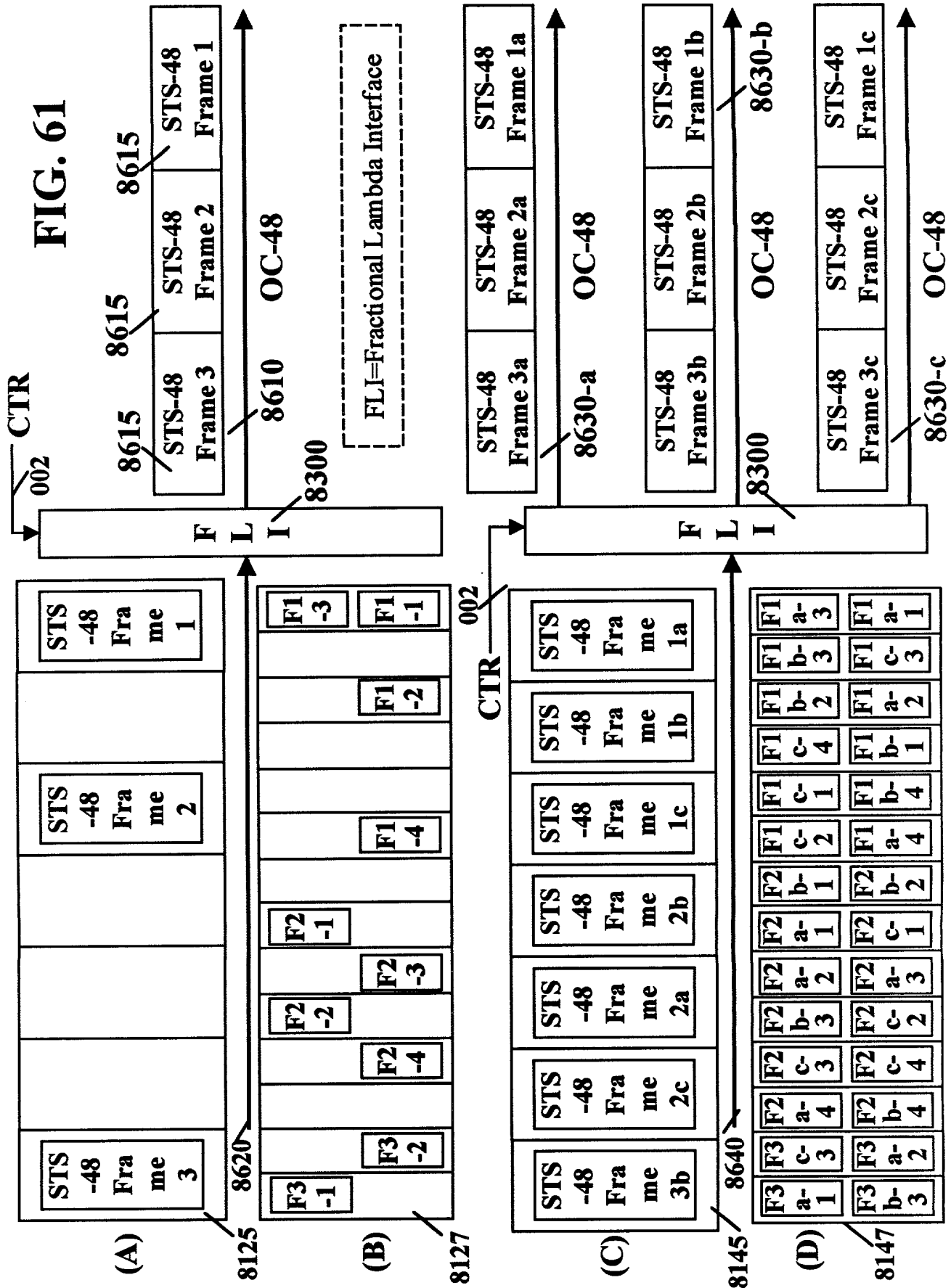


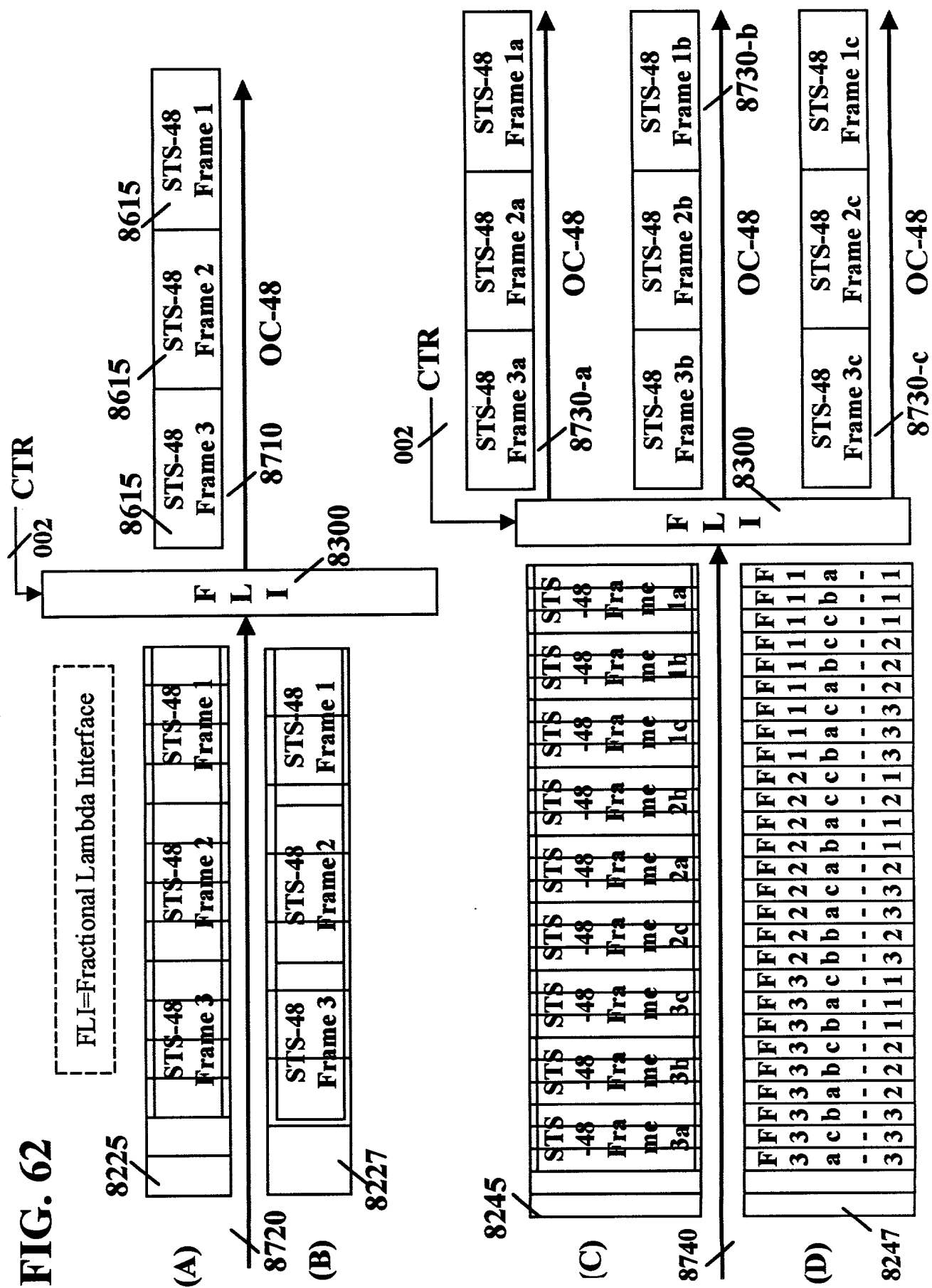
FLP = Fractional Lambda Pipe

SONET Fractional Lambda Interface - Egress Module



FLP = Fractional Lambda Pipe



[illegible]

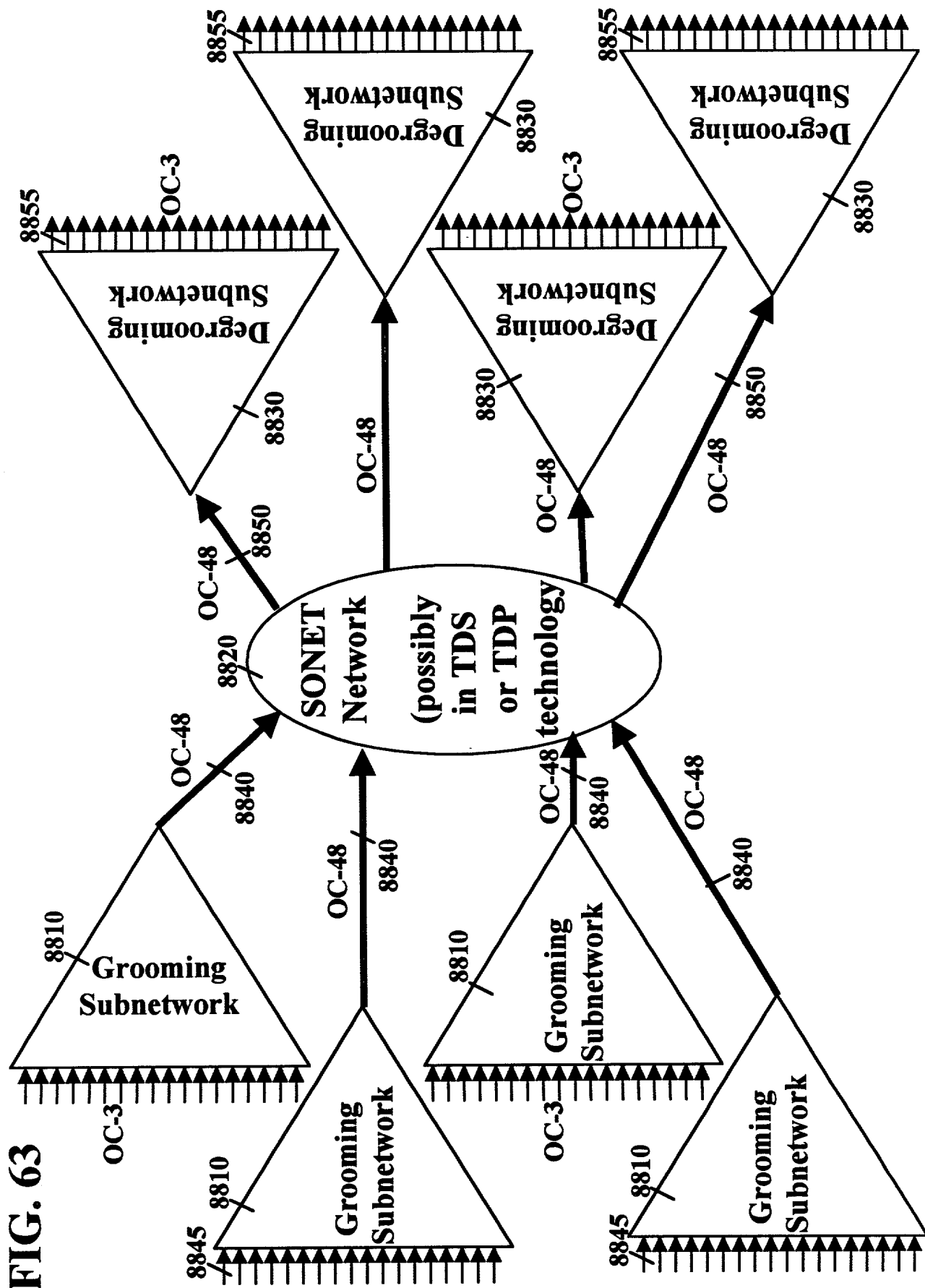
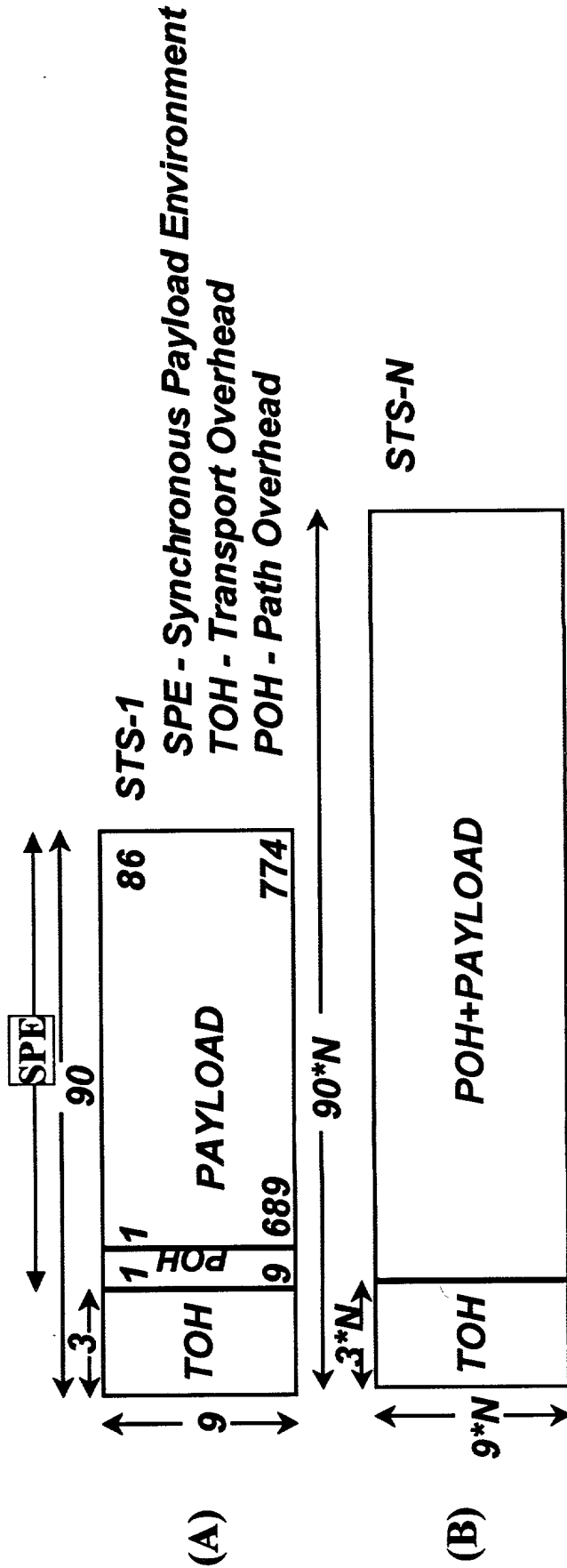


FIG. 63

FIG. 64

- SONET - synchronous optical network
- Multiplexing method: byte interleaving
- Signal hierarchy: OC-N (STS-N)
 - STS-N rate: $N \times 51.84$ Mb/s
 - Frame format: 9 rows by $90 \times N$ columns
 - capacity: $N \times 810$ bytes in 125 microsecond.
 - overhead: $N \times 27$ bytes
 - payload: $N \times 783$ bytes



Parameter	Unit	Value	Standard Error	t-Statistic	p-Value
Intercept		1.0000	0.0000	1.0000	0.0000
Age	Years	0.0500	0.0100	5.0000	0.0000
Gender	Male/Female	0.1000	0.0200	5.0000	0.0000
Marital Status	Married/Single	0.2000	0.0400	5.0000	0.0000
Education	Years	0.0200	0.0050	4.0000	0.0000
Income	Dollars	0.0001	0.0000	10.0000	0.0000
Health	Good/Bad	0.3000	0.0600	5.0000	0.0000
Religion	Protestant/Catholic	0.1500	0.0300	5.0000	0.0000
Occupation	Manager/Worker	0.2500	0.0500	5.0000	0.0000
Region	North/South	0.1000	0.0200	5.0000	0.0000
Time	Years	0.0100	0.0020	5.0000	0.0000

